

INSTALLATION, OPERATING AND SERVICE INSTRUCTIONS FOR LEDV SERIES DIRECT VENT OIL FIRED BOILER



As an ENERGY STAR Partner, Burnham Corporation has determined that the LEDV-1, fired at the 0.60 GPH rate, meets the ENERGY STAR guidelines for Energy efficiency established by the United States Environmental Protection Agency (EPA).

For service or repairs to boiler, call your heating contractor. When seeking information on boiler, provide Boiler Model Number and Serial Number as shown on Rating Label.

Boiler Model Number LEDV__ - _____	Boiler Serial Number 6 _ _ _ _ _	Installation Date
Heating Contractor		Phone Number
Address		

Burnham®
AMERICA'S BOILER COMPANY
Burnham Corporation
Lancaster, PA 17604-3079

IMPORTANT INFORMATION - PLEASE READ THIS PAGE CAREFULLY

The following terms are used throughout this manual to bring attention to the presence of hazards of various risk levels, or to important information concerning product life.

DANGER

DO NOT store or use gasoline or other flammable vapors or liquids in the vicinity of this or any other appliance.

If you smell gas vapors, **DO NOT** try to operate any appliance - **DO NOT** touch any electrical switch or use any phone in the building. Immediately, call the gas supplier from a remotely located phone. Follow the gas supplier's instructions or if the supplier is unavailable, contact the fire department.

WARNING

Improper installation, adjustment, alteration, service or maintenance can cause property damage, personal injury or loss of life. Failure to follow all instructions in the proper order can cause personal injury or death. Read and understand all instructions, including all those contained in component manufacturers manuals which are provided with the appliance before installing, starting-up, operating, maintaining or servicing this appliance. Keep this manual and literature in legible condition and posted near appliance for reference by owner and service technician.

This boiler requires regular maintenance and service to operate safely. Follow the instructions contained in this manual. Installation, maintenance, and service must be performed only by an experienced, skilled installer or service agency. All heating systems should be designed by competent contractors and only persons knowledgeable in the layout and installation of hydronic heating systems should attempt installation of any boiler. It is the responsibility of the installing contractor to see that all controls are correctly installed and are operating properly when the installation is completed. Installation is not complete unless a pressure relief valve is installed into the tapping located on top of appliance - See Section III of this manual for details.

WARNING

Boiler materials of construction, products of combustion and the fuel contain alumina, silica, heavy metals, carbon monoxide, nitrogen oxides, aldehydes and/or other toxic or harmful substances which can cause death or serious injury and which are known to the state of California to cause cancer, birth defects and other reproductive harm. Always use proper safety clothing, respirators and equipment when servicing or working nearby the boiler.

This boiler contains very hot water under high pressures. Do not unscrew any pipe fittings nor attempt to disconnect any components of this boiler without positively assuring the water is cool and has no pressure. Always wear protective clothing and equipment when installing, starting up or servicing this boiler to prevent scald injuries. Do not rely on the pressure and temperature gauges to determine the temperature and pressure of the boiler. This boiler contains components which become very hot when the boiler is operating. Do not touch any components unless they are cool.

This boiler must be properly vented and connected to an approved vent system in good condition. Serious property damage could result if the boiler is connected to an unapproved vent system.

This boiler needs fresh air for safe operation and must be installed so there are provisions for adequate combustion and ventilation air.

The interior of the venting and air intake systems must be inspected and cleaned before the start of the heating season and should be inspected periodically throughout the heating season for any obstructions. Clean and unobstructed venting and air intake systems are necessary to allow noxious fumes that could cause injury or loss of life to vent safely and will contribute toward maintaining the boiler's efficiency.

This boiler is supplied with controls which may cause the boiler to shut down and not re-start without service - If damage due to frozen pipes is a possibility, the heating system should not be left unattended in cold weather; or appropriate safeguards and alarms should be installed on the heating system to prevent damage if the boiler is inoperative.

This boiler is designed to burn No. 2 fuel oil only. Do not use gasoline, crankcase drainings, or any oil containing gasoline. Never burn garbage or paper in this boiler. Do not convert to any solid fuel (i. e. wood, coal) or gaseous fuel (i. e. natural gas, LP/propane). All flammable debris, rags, paper, wood scraps, etc., should be kept clear of the boiler at all times. Keep the boiler area clean and free of fire hazards.

All boilers equipped with Burner Swing Door have a potential hazard which can cause severe property damage, personal injury or loss of life if ignored. Before opening swing door, turn off service switch to boiler and disconnect two halves of Burner Swing Door Interlock wiring harness to prevent accidental firing of burner outside the combustion chamber. Be sure to tighten swing door fastener completely and reconnect two halves of Burner Swing Door Interlock when service is completed.

NOTICE

This boiler has a limited warranty, a copy of which is printed on the back of this manual. It is the responsibility of the installing contractor to see that all controls are correctly installed and are operating properly when the installation is complete. The warranty for this boiler is valid only if the boiler has been installed, maintained and operated in accordance with these instructions.

NOTICE

All boilers must be installed in accordance with National, State and Local Plumbing, Heating and Electrical Codes and the regulations of the serving utilities which may differ from this manual. Authorities having jurisdiction should be consulted before installations are made.

In all cases, reference should be made to the following Standards:

USA BOILERS

- A. Current Edition of American National Standard ANSI/NFPA 31, "Installation of Oil Burning Equipment", for recommended installation practices.
- B. Current Edition of American National Standard ANSI/NFPA 211, "Chimneys, Fireplaces, Vents, and Solid Fuel Burning Appliances", For Venting requirements.
- C. Current Edition of American Society of Mechanical Engineers ASME CSD-1, "Controls and Safety Devices for Automatically Fired Boilers", for assembly and operations of controls and safety devices.

CANADIAN BOILERS

- A. Current Edition of Canadian Standards Association CSA B139, "Installation Code for Oil Burning Equipment", for recommended Installation Practices.

This boiler is suitable for installation on combustible flooring. Boiler cannot be installed on carpeting.

For optimum performance and serviceability from this unit adhere to the following recommendations:

- A. Do not tamper with or alter the unit or controls. Retain your contractor or a competent serviceman to assure that the unit is properly adjusted and maintained.
- B. Clean firetubes at least once a year - preferably at the start of the heating season to remove soot and scale. Inside of Combustion Chamber should also be cleaned at the same time.
- C. Have Oil Burner and Controls checked at least once a year or as may be necessitated.
- D. Do not operate unit with jumpered or absent controls or devices.
- E. Do not operate unit if any control, switch, component, or device has been subject to water.

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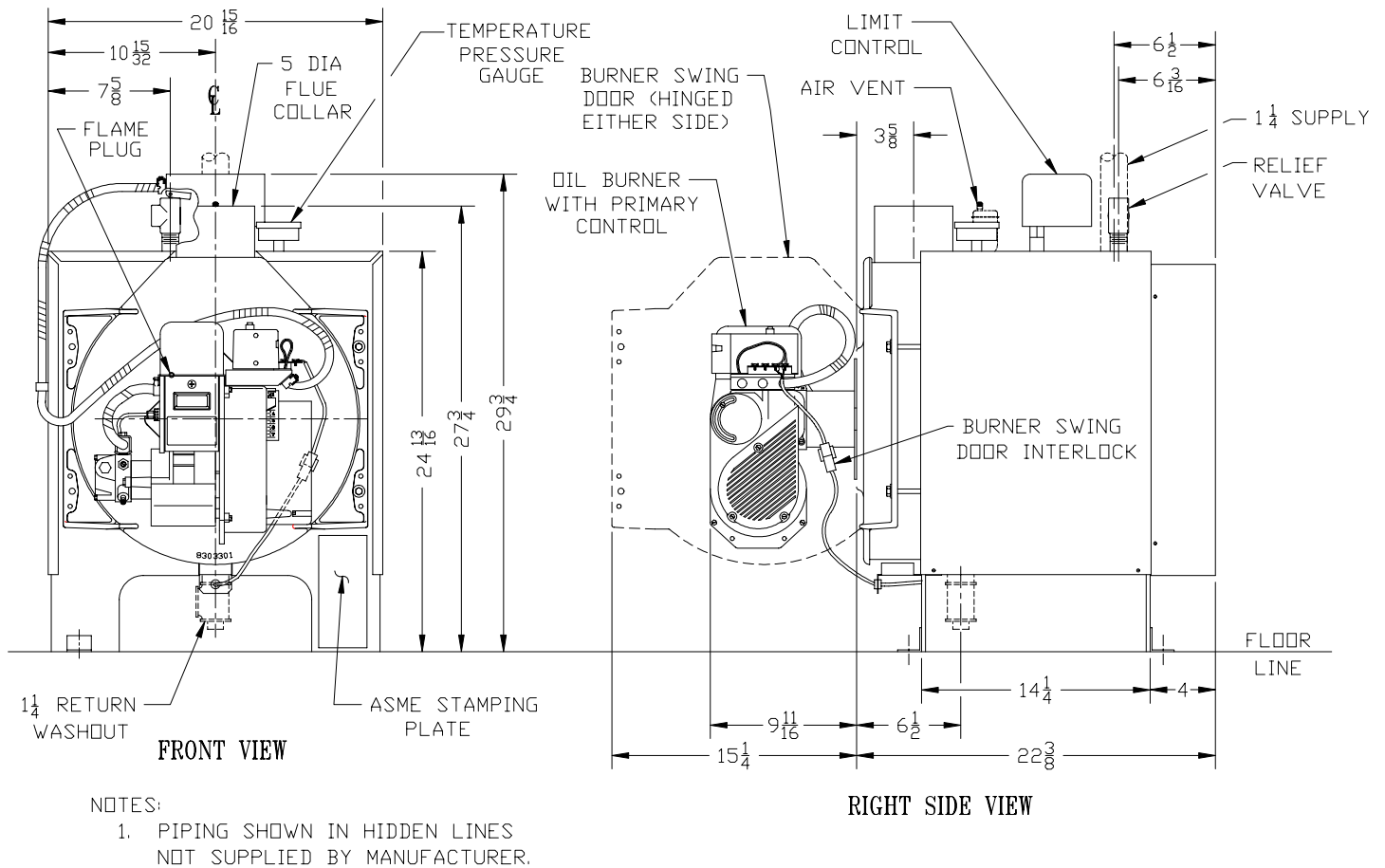


Figure 1: LEDV Packaged Boiler

I. Pre-Installation

A. INSPECT SHIPMENT carefully for any signs of damage.

1. **ALL EQUIPMENT** is carefully manufactured, inspected and packed. Our responsibility ceases upon delivery of crated boiler to the carrier in good condition.
2. **ANY CLAIMS** for damage or shortage in shipment must be filed immediately against the carrier by the consignee. No claims for variances from, or shortage in orders, will be allowed by the manufacturer unless presented within sixty (60) days after receipt of goods.

B. LOCATE BOILER in front of final position before removing crate. See Figure 1. Boiler's approximate shipping weight is 325 pounds.

1. **LOCATE** so that vent pipe will be short and direct. Refer to Section V. A., General Venting Guidelines.
2. **BOILER IS SUITABLE FOR INSTALLATION ON COMBUSTIBLE FLOOR.** Boiler cannot be installed on carpeting.
3. **FOR BASEMENT INSTALLATION**, provide a solid base, such as concrete, if floor is not level, or if water may be encountered on floor around boiler.
4. **PROVIDE SERVICE CLEARANCE** of at least 24" at front of boiler for servicing.
5. For minimum clearances to combustible materials, see Figure 2.

C. PROVIDE COMBUSTION AIR SUPPLY to accommodate proper combustion of oil. Local and national codes may apply and should be referenced.

1. In unconfined spaces (basement) in buildings of conventional frame, brick, or stone construction, infiltration normally is adequate to provide air for combustion. An unconfined space is a space whose volume is greater than or equal to 50 cubic feet per 1000 BTUH of the combined input of all air consuming appliances in the space.
2. In a confined space, combustion air may be ducted directly from the outdoors to the burner. Refer to Section IV for installation of air intake duct to the burner.

D. VENTILATION AIR must be provided to maintain the ambient temperature at safe limits. Local and national codes may apply and should be referenced.

1. In unconfined spaces (basement) in buildings of conventional frame, brick, or stone construction, infiltration normally is adequate to provide air for ventilation.
2. In confined spaces (closet, etc.) two permanent openings, one near the top of the enclosure and one near the bottom, shall be provided. Each opening shall have a free area of not less than 1 sq. inch per 1000 BTUH of the total input of all appliances in the space.

E. Do not install boiler where gasoline or other flammable vapors or liquids, or sources of hydrocarbons (i.e. bleaches, cleaners, chemicals, sprays, paint removers, fabric softeners, etc.) are used or stored.

II. Unpack Boiler

CAUTION

Do not drop boiler. Do not bump boiler jacket against floor.

A. REMOVE CRATE

1. Remove all fasteners at crate skid.
2. Lift outside container and remove all other inside protective spacers and bracing. Remove vacuum relief valve and miscellaneous trim bag containing safety/relief valve, and pipe fittings.

B. REMOVAL OF BOILER FROM SKID

1. Boiler is secured to base with 2 bolts, 1 at left front and 1 at right rear. Remove both bolts.
2. Tilt boiler, "walk" boiler backward, and set rear legs down on floor. Tilt boiler backward, pull skid forward and set front legs down on edge of skid. Install close nipple, tee, and plug in return coupling. See Section III and Figure 5. Point tee toward permanent return location.
3. Tilt boiler backward and remove skid. Be careful not to damage Burner or Jacket.

C. DETERMINE PROPER HINGE LOCATION FOR BURNER SWING DOOR. Boiler is shipped with hinges on left side. Approximately 12 inches are required on the hinge side for burner clearance. If there will be less than 12 inches from left side of boiler to wall, move hinges to right side (refer to Paragraph D).

D. HINGE LOCATION CHANGE (if required).

1. Pull 2 halves of Burner Swing Door Interlock apart. Swing Door Interlock is connected to R-W terminals on R8184P Control. Lift Honeywell R8184P Control off of Burner Junction Box and disconnect wiring harness from burner.
2. Remove 8 sheet metal screws from jacket. Remove rear jacket box and bend both sides of Jacket Wrapper up, see Figure 20.
3. Remove 2 (two) 5/16" - 18 x 3" long hex head cap screws and flat washers from right side of door. Remove 2 hairpin cotter pins and 2 hinge pins from hinges on left side of door and remove Door Assembly from boiler. Inspect Front and Rear Door Insulation Pieces and Combustion Chamber Liner, see Paragraph G.

4. Remove 4 hex nuts from bolts that attach hinges and hinge spacers to left side of Tubesheet. Remove 4 hex head cap screws that attach hinges to door.
5. Attach 2 hinge brackets & spacers to Tubesheet and 2 hinge brackets to Door on right side of boiler. 3 Holes in each Hinge Bracket must line up with 3 matching holes in Spacer, Tubesheet or Door. See Figure 3. Tighten hex nuts, bolts and screws by hand only.
6. Replace door assembly. Hinge brackets attached to door must rest on top of hinge brackets attached to tubesheet. See Figure 4. Slide hinge pins through hinges from top and install cotter pins. Close door and install 5/16" - 18 x 3" long hex head cap screws through flat washers and left side of door and into tapped holes in tubesheet. Tighten all hex nuts, bolts and screws. When door is installed properly, it is parallel to Tubesheet when viewed from top and sides.
7. Bend sides of Jacket Wrapper down and attach 2 Jacket Straps to 4 slots at bottom of Jacket Wrapper sides with sheet metal screws. Install Rear Jacket Box with 4 sheet metal screws. See Figure 20.
8. Connect wiring harness to burner Junction Box and install Honeywell R8184P Control, see Wiring Diagram, Figure 15. Reconnect Swing Door Interlock.

E. INSTALL BOILER CONTROL.

1. Pull bulb and capillary tube out of hole in back of control. Insert bulb in immersion well on top of boiler and secure control with set screw in control.
2. Secure flexible conduit to Jacket Wrapper side with conduit clamp and sheet metal screw. Conduit must be on same side of boiler as Swing Door hinges.

F. MOVE BOILER TO PERMANENT POSITION by sliding or walking.

G. INSPECT FRONT AND REAR DOOR INSULATION AND COMBUSTION CHAMBER LINER

1. OPEN BURNER SWING DOOR on front of boiler. Use flashlight to inspect insulation secured to front and rear doors. Inspect ceramic fiber blanket secured to bottom of combustion chamber. Inspect inner and outer door gaskets. Replace any damaged pieces.

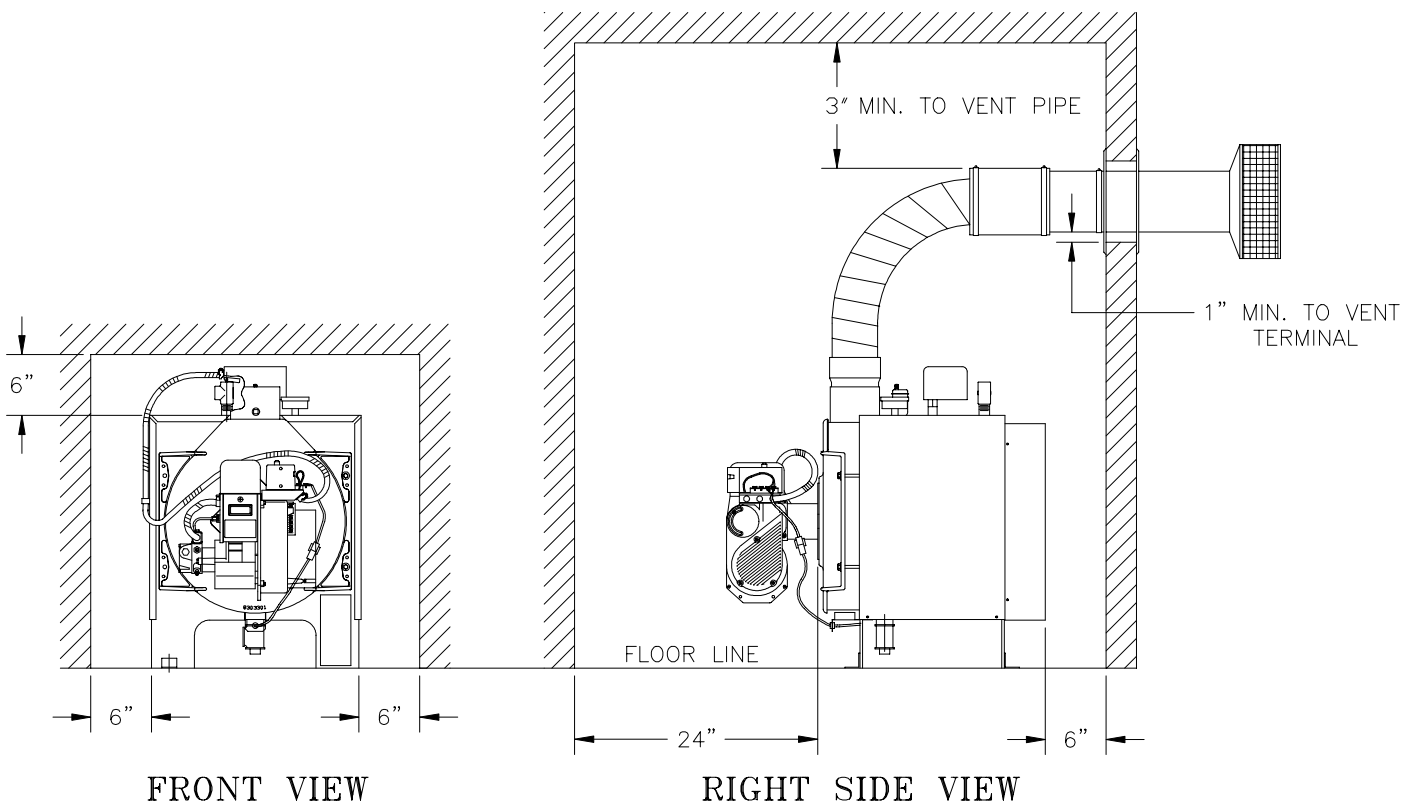
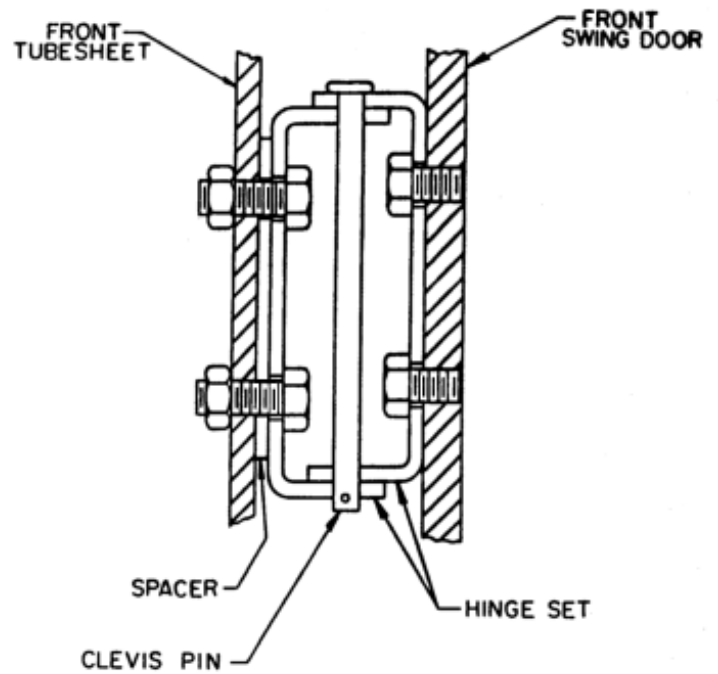
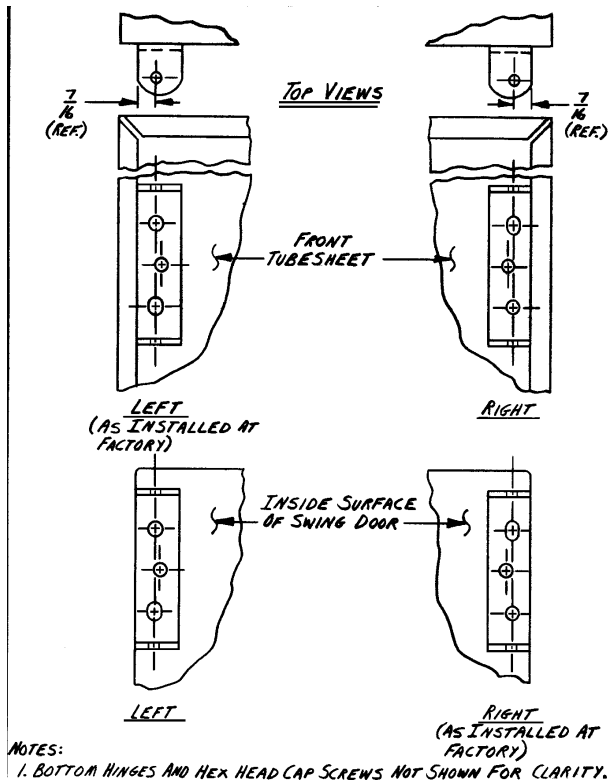


Figure 2: Minimum Clearances to Combustible Materials

III. Water Piping and Trim

A. Design and install boiler and system piping to prevent oxygen contamination of boiler water.

There are many possible causes of oxygen contamination such as:

1. Addition of excessive make-up water as a result of system leaks.
2. Absorption through open tanks and fittings.
3. Oxygen permeable materials in the distribution system.

In order to insure long product life, oxygen sources should be eliminated. This can be accomplished by taking the following measures:

1. Repairing system leaks to eliminate the need for addition of make-up water.
2. Eliminating open tanks from the system.
3. Eliminating and/or repairing fittings which allow oxygen absorption.
4. Use of non-permeable materials in the distribution system.
5. Isolating the boiler from the system water by installing a heat exchanger.

B. Connect System supply and return piping to boiler. See Figures 5 and 7. Also consult I=B=R Installation and Piping Guides. Maintain minimum ½ inch clearance from hot water piping to combustible materials.

1. If this boiler is used in connection with refrigeration systems, the boiler must be installed so that the chilled medium is piped in parallel with the heating boiler using appropriate valves to prevent the chilled medium from entering the boiler, see Figure 6. Also consult I=B=R Installation and Piping Guides.
2. If this boiler is connected to heating coils located in air handling units where they may be exposed to

refrigerated air, the boiler piping must be equipped with flow control valves to prevent gravity circulation of boiler water during the operation of the cooling system.

3. If boiler is used with an Alliance Indirect-Fired Domestic Water Heater, install the Alliance as a separate heating zone. Refer to the Alliance Installation, Operating, and Service Instructions for additional information.
4. Use a system bypass if the boiler is to be operated in a system which has a large volume or excessive radiation where low boiler water temperatures may be encountered (i.e. converted gravity circulation system, etc.).
The bypass should be the same size as the supply and return lines with valves located in the bypass and return line as illustrated in Figures 5 and 7 in order to regulate water flow for maintenance of higher boiler water temperature.
Set the by-pass and return valves to a half throttle position to start. Operate boiler until the system water temperature reaches its normal operating range.
Adjust the valves to maintain 180°F to 200°F boiler water temperature and greater than 120°F return temperature. Adjust both valves simultaneously. Closing the boiler return valve while opening the by-pass valve will raise the boiler return temperature. Opening the boiler return valve while closing the by-pass valve will lower the boiler return temperature.
5. A hot water boiler installed above radiation level must be provided with a low water cutoff device as part of the installation.

C. Install Safety Relief Valve. See Figures 5 and 7. Safety Relief Valve must be installed with spindle in vertical position. Installation of the relief valve must be consistent with the ANSI/ASME Boiler and Pressure Vessel Code, Section IV.

WARNING

Safety (relief) valve discharge piping must be piped near floor to eliminate potential of severe burns. Do not pipe in any area where freezing could occur. Do not install any shut-off valves, plugs or caps.

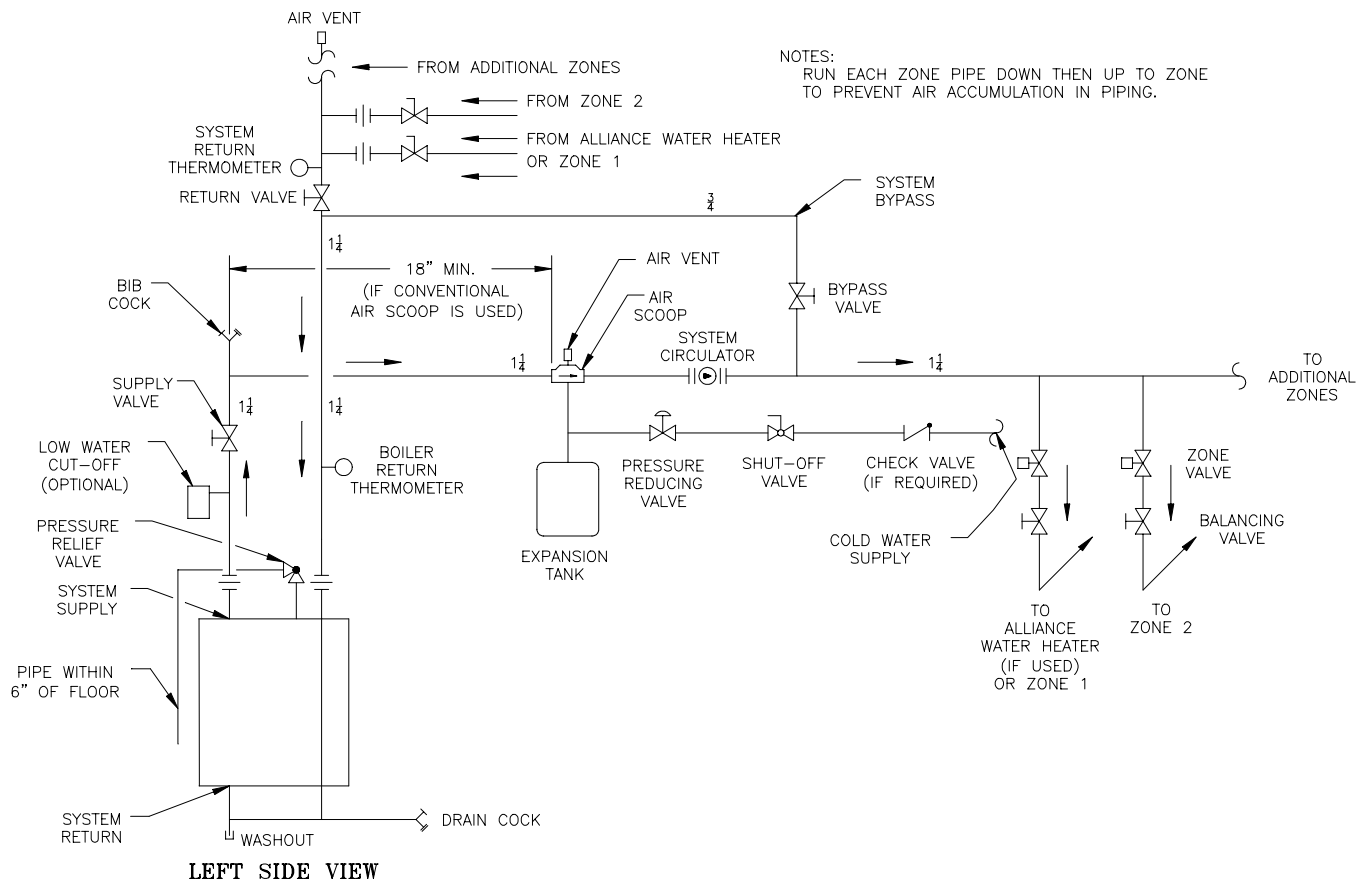


Figure 5: Recommended Boiler Piping for Zoning with Valves

D. Install Drain Valve in return piping. See figure 5.

E. Oil, grease, and other foreign materials which accumulate in new hot water boilers and a new or reworked system should be boiled out, and then thoroughly flushed. A qualified water treatment chemical specialist should be consulted for recommendations regarding appropriate chemical compounds and concentrations which are compatible with local environmental regulations.

F. After the boiler and system have been cleaned and flushed, and before refilling the entire system add appropriate water treatment chemicals, if necessary, to bring the pH between 7 and 11.

G. Fill entire heating system with water and vent air from system. Use the following procedure on a Series Loop System equipped with zone valves. (See Figure 5).

1. Close isolation valve in boiler supply piping.
2. Isolate all circuits by closing zone valves or balancing valves.
3. Attach a hose to bib cock located just below

isolation valve in boiler supply piping. (Note - Terminate hose in five gallon bucket at a suitable floor drain or outdoor area).

4. Starting with one circuit, open zone valve.
5. Open bib cock.
6. Open fill valve (Make-up water line should be located directly above isolation valve in boiler supply piping).
7. Allow water to overflow from bucket until discharge from hose is bubble free for 30 seconds.
8. Open zone valve to the second zone to be purged, then close the first. Repeat this step until all zones have been purged, but always have one zone open. At completion, open all zone valves.
9. Close bib cock, continue filling the system until the pressure gauge reads 12 psi. Close fill valve. (Note - If make-up water line is equipped with pressure reducing valve, system will automatically fill to 12 psi).
10. Open isolation valve in boiler supply piping.
11. Remove hose from bib cock.

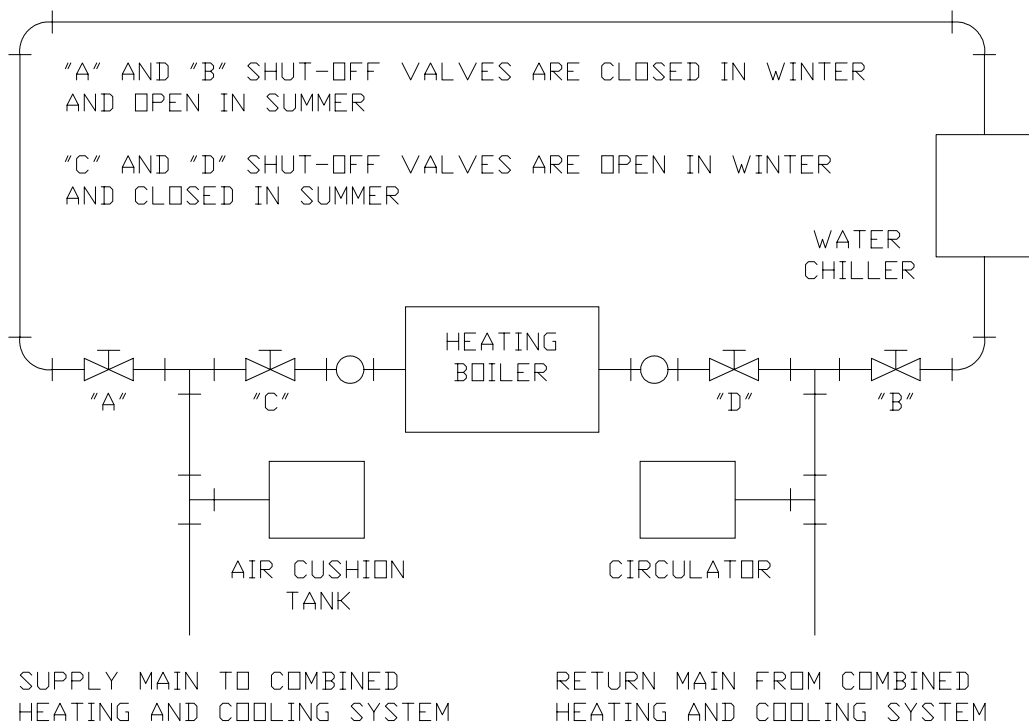


Figure 6: Recommended Piping for Combination Heating & Cooling (Refrigeration) Systems

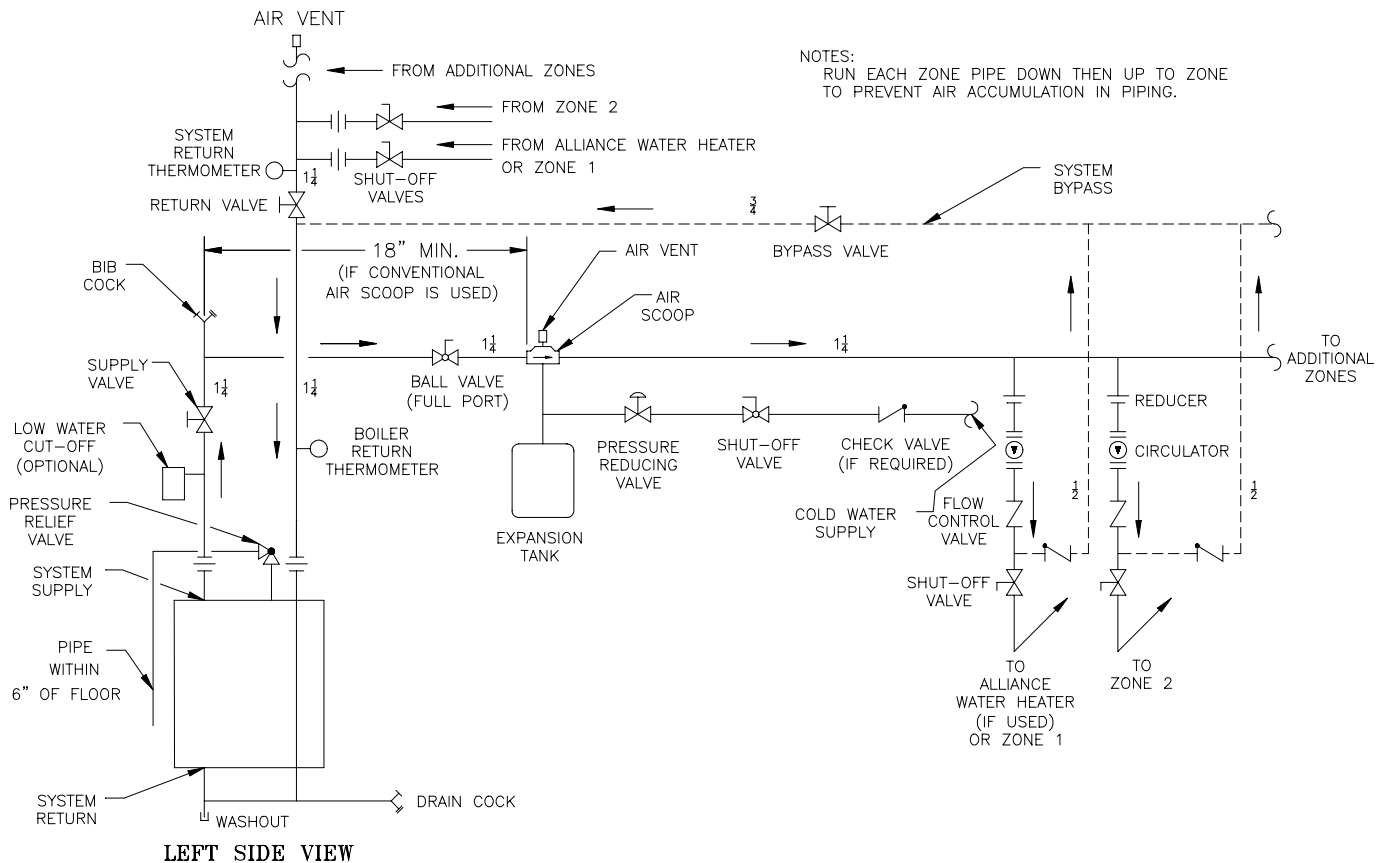


Figure 7: Recommended Boiler Piping for Zoning with Circulators

IV. Venting / Air Intake Piping

A. General Guidelines

1. Vent system installation must be in accordance with these instructions and applicable provisions of local building codes. Contact local building or fire officials about restrictions and installation inspection in your area.
2. The LEDV Series is designed as a Direct Vent boiler. In this configuration, all air for combustion is supplied directly to the burner from outdoors and flue gases are vented directly outdoors (through wall). See Figures 10 and 11. The LEDV may be side-wall vented with combustion air supplied from indoors. This configuration may be used in installations where infiltration provides adequate air for combustion and ventilation. Flue gases are still vented directly outdoors (through wall).
3. For minimum clearances to combustibles materials refer to Figure 2.
4. Maximum wall thickness that vent terminal may be installed through is 10 inches.
5. Vent Terminal Location (see Figure 8). Locate vent terminal so vent pipe is short and direct. The vent terminal must be located:
 - a. Not less than 12 inches above grade plus snow accumulation.
 - b. Not less than 4 feet below, 4 feet horizontally, or 1 foot above any door, window, or gravity air inlet.
 - c. Not less than 3 feet above any forced air inlet located within 10 feet.
 - d. Not less than 2 feet from an adjacent building.
 - e. Not less than 7 feet above a public walkway.

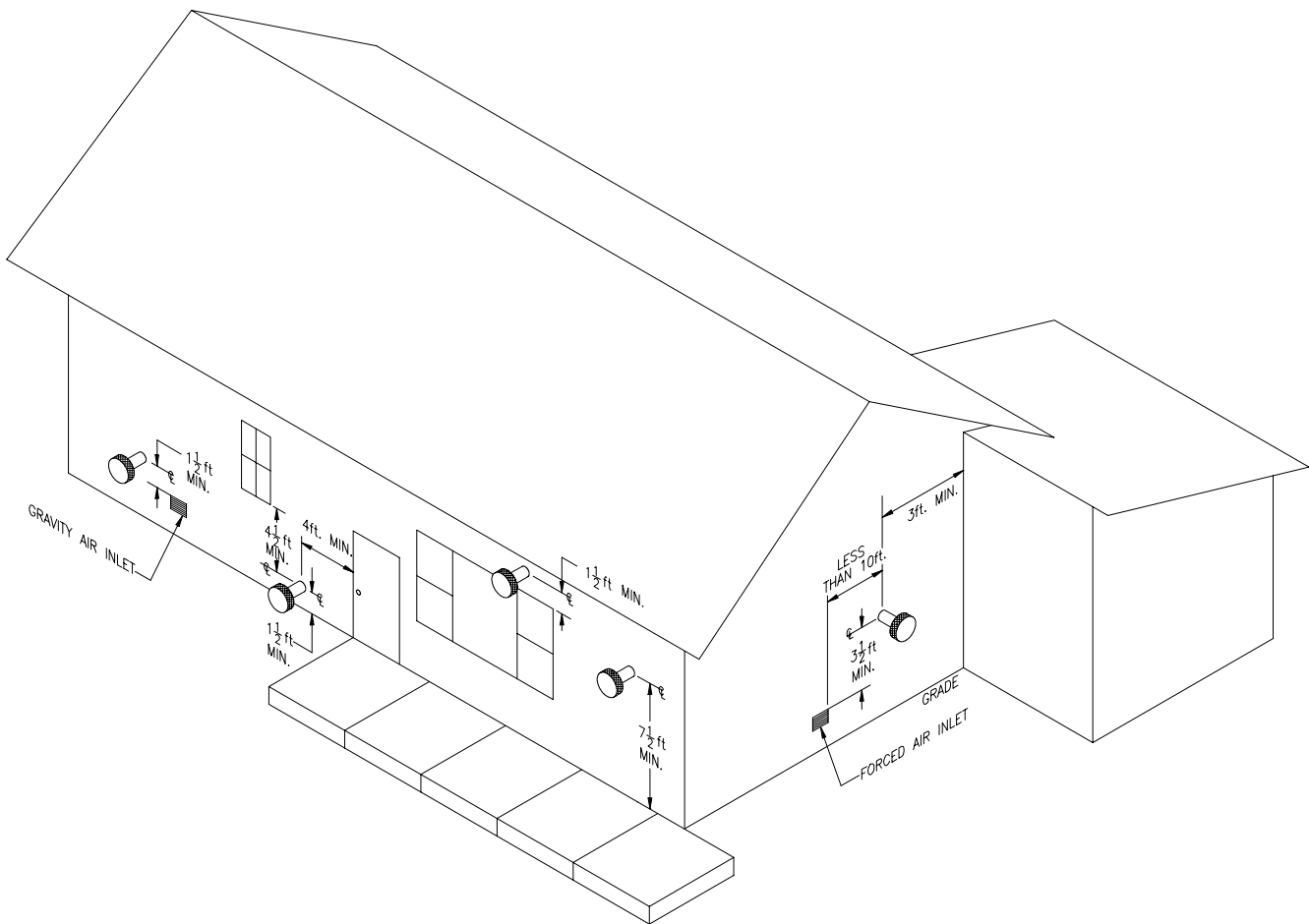


Figure 8: Vent Terminal Location

6. Intake Terminal Location (Direct Vent only) - Locate Air Intake Terminal not less than 12 inches to the left, right, or bottom of the vent terminal. Do not locate air intake terminal above vent terminal. Intake terminal must be at least 12 inches above grade plus snow accumulation. See Figure 9.
7. The LEDV must be vented with 4" Z-Flex Direct Oil™ Vent. 20 feet is the maximum vent length allowed. The vent pipe is available in 5, 10, 15, and 20 foot lengths. Table 1 lists vent part numbers.

Table 1: Vent Pipe Part Numbers

4" Direct Oil™ Vent Pipe	
Pipe Length	Burnham Part No.
5 Ft.	8113302
10 Ft.	8113303
15 Ft.	8113304
20 Ft.	8113305

8. The vent system must be completed with the Direct Oil™ Vent Kit, which is shipped with the boiler.

B. Vent Installation (Direct Vent and Side-Wall Vent)

1. Install Vent Terminal. See Figure 10.
 - a. After determining the location from previous Section, cut an opening in the wall for the vent terminal.
 - Combustible wall: 8 inches diameter hole is required to maintain a 1 inch clearance to combustible materials.
 - Non-combustible wall: 6½ inches diameter hole is required.
 - b. Secure trim plate to outside wall.
 - c. Insert the vent terminal through the opening until the stop bead rest against the trim plate.
 - d. Slide the inside trim plate assembly (fitted with gear clamp) onto the terminal pipe.

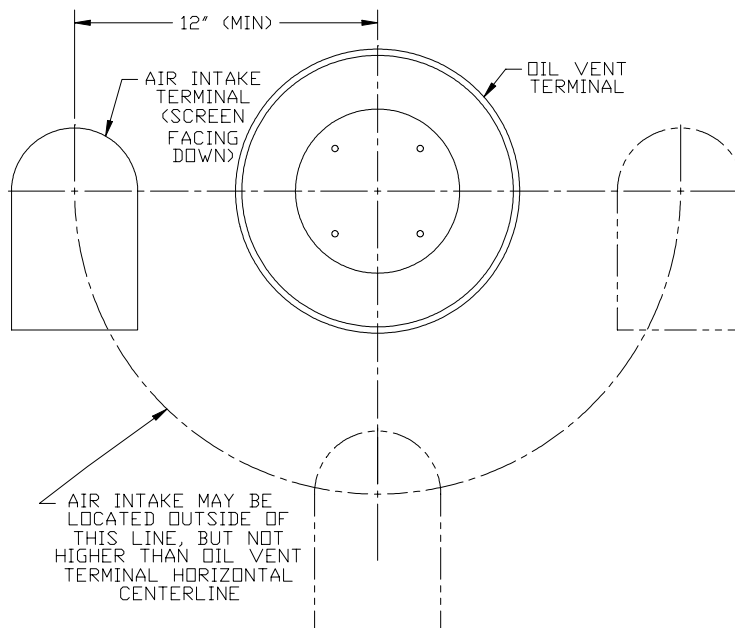


Figure 9: Intake Terminal Location

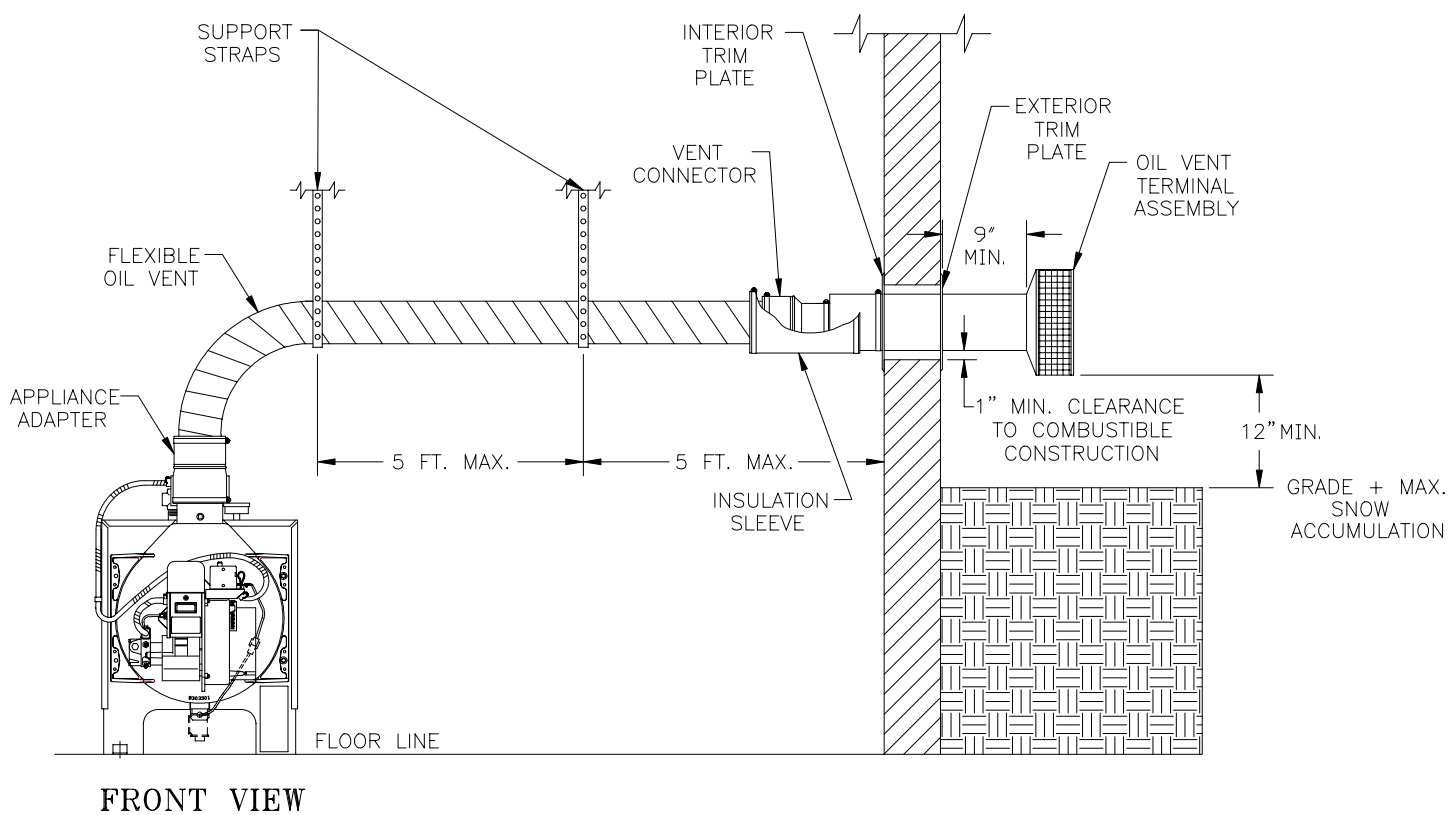


Figure 10: Vent Installation

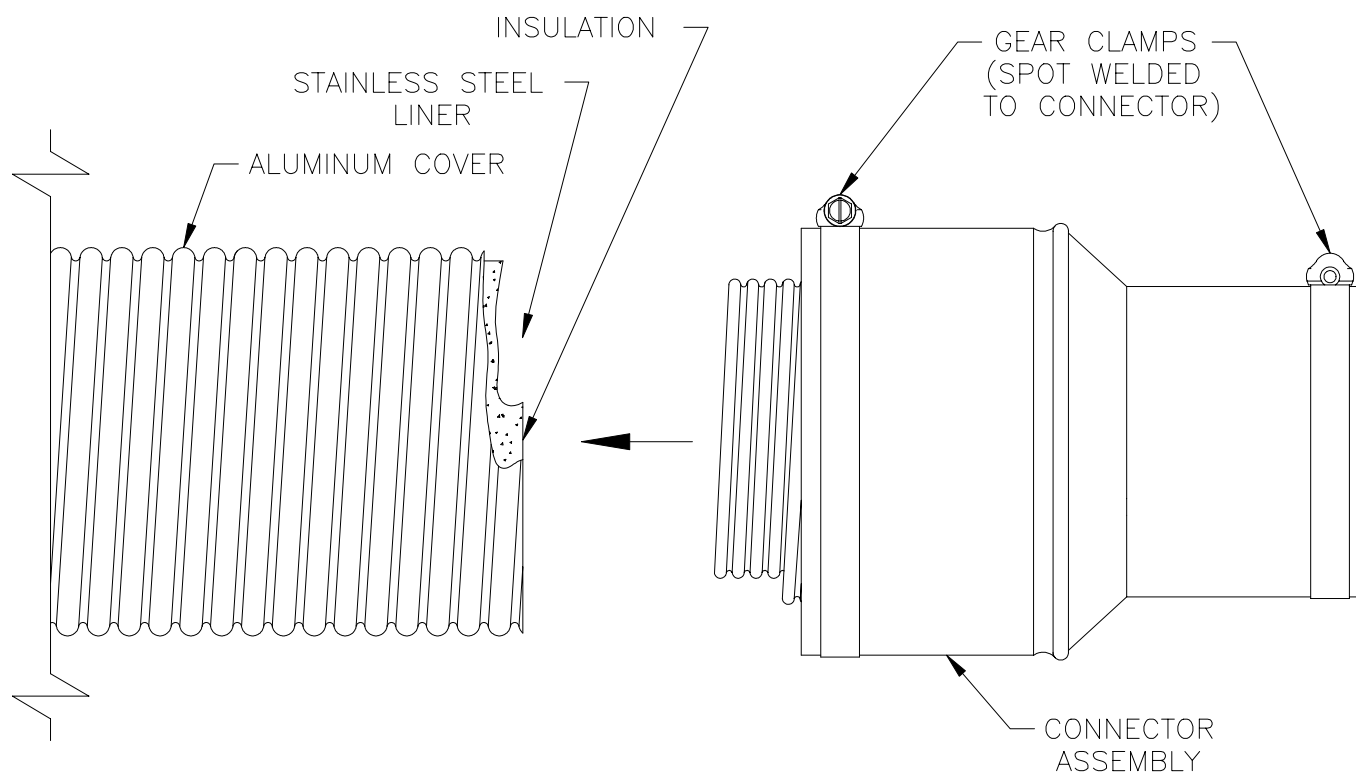


Figure 11: Vent Connector, Un-Assembled

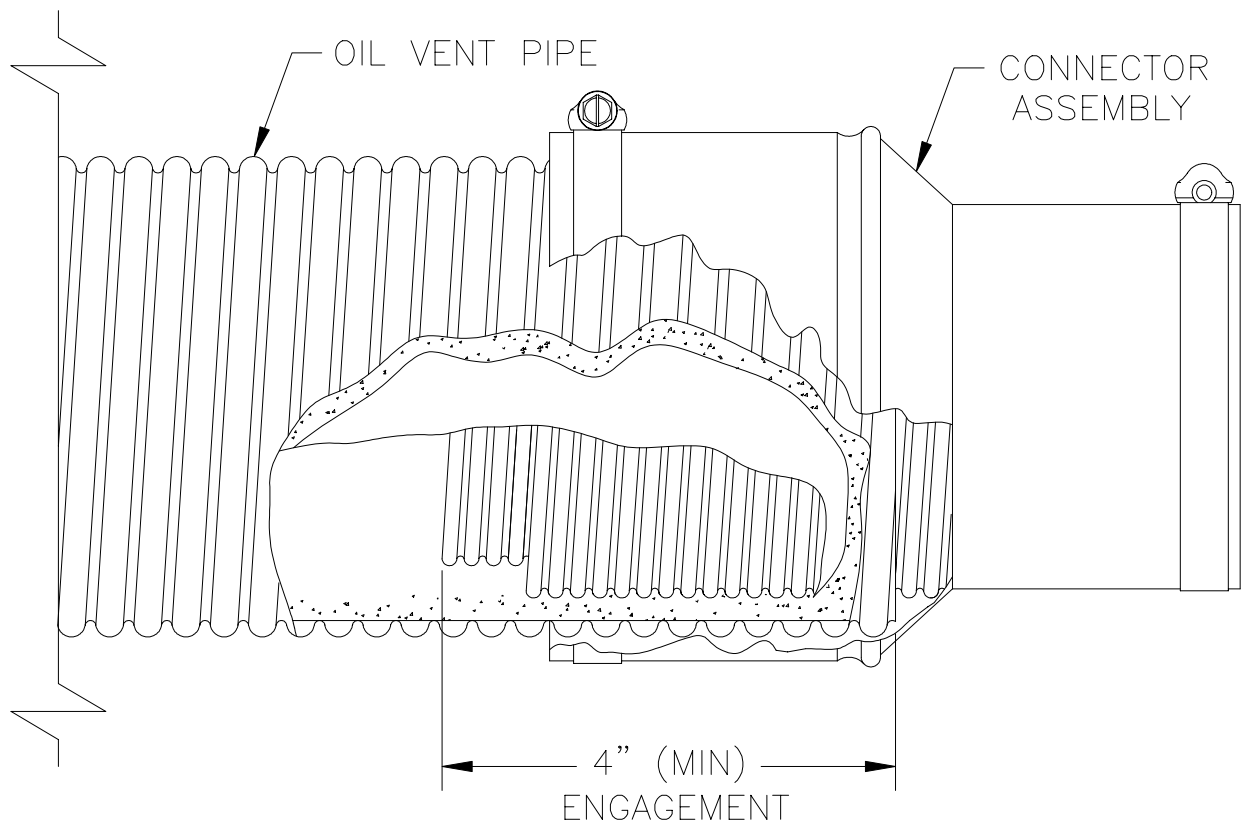


Figure 12: Vent Connector, Assembled

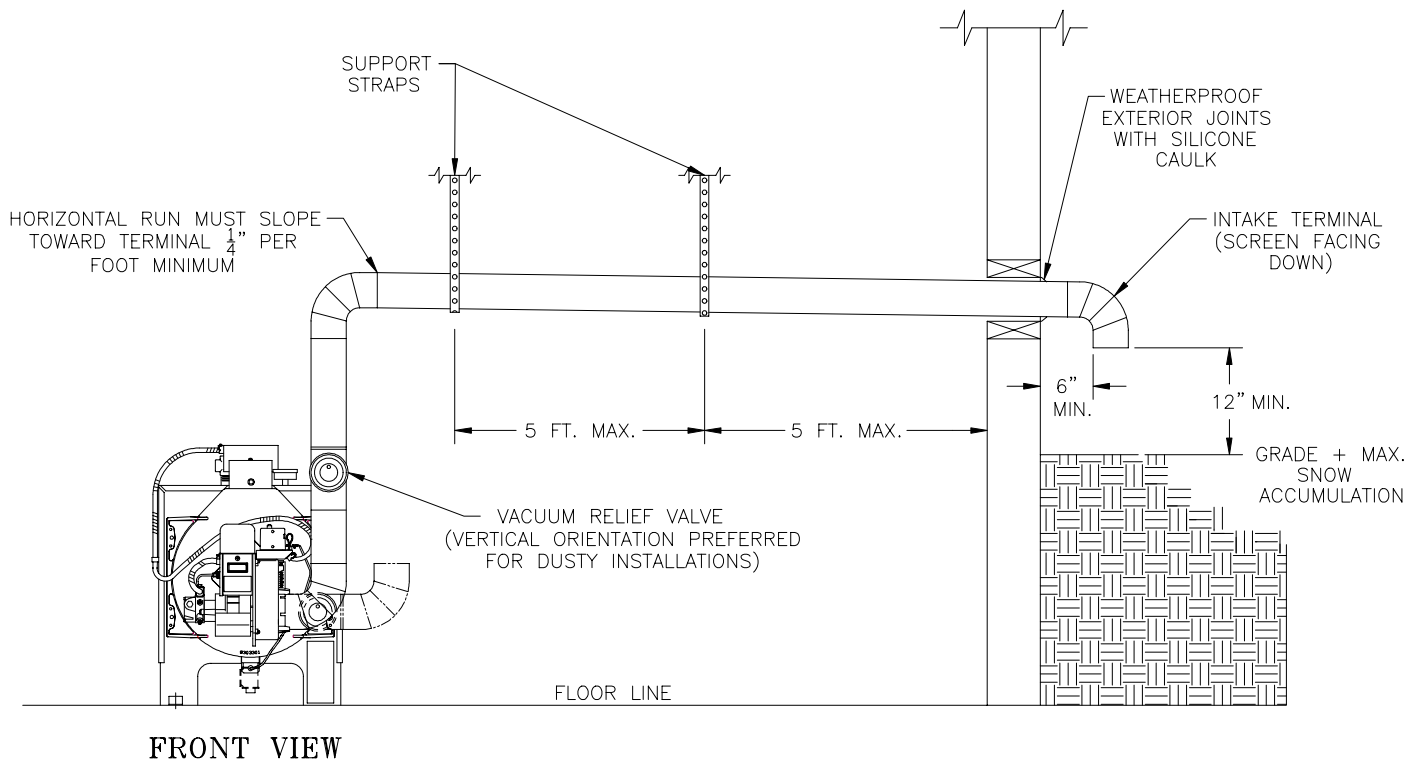


Figure 13: Air Intake Installation

- e. Secure the inside trim plate to inside wall.
 - f. Tighten the gear clamp to the terminal pipe.
 - g. Seal all external joints with a weatherproof caulk.
2. Cut vent pipe to length with a hack saw.
 3. Install Vent Connector/Appliance Adaptor. See Figures 11 and 12.
 - a. Apply a continuous bead of high temperature adhesive/sealant (supplied with boiler) around outside of corrugated pipe of vent connector.
 - b. Twist vent connector into end of vent pipe. Turn the connector counter-clockwise until it is engaged approximately 4 inches into the inner vent pipe and the outer collar of the connector overlaps the outside of the vent pipe.
 - c. Tighten the gear clamp on the outer collar of the connector.
 - d. Repeat steps a. through c. with the appliance adaptor.
 4. Connect vent pipe to boiler.
 - a. Apply a continuous bead of high temperature adhesive/sealant (supplied with boiler) to inside of appliance adaptor (approximately ½ inch from end).
 - b. Slip appliance adaptor over boiler flue collar and tighten gear clamp.
 5. Connect vent pipe to terminal.
 - a. Carefully slide insulation sleeve over vent connector and vent pipe until gear clamp on small end of connector can be accessed.
 - b. Apply a continuous bead of high temperature adhesive/sealant (supplied with boiler) on inside of vent connector (approximately ½ inch from end).
 - c. Clip connector over vent terminal until it is fully engaged. Then tighten gear clamp.
 - d. Slide insulation sleeve over terminal connection so that connector is completely covered.
 - e. Secure each end of insulation sleeve with the gear clamps provided.
 6. Secure vent pipe in position with pipe straps.

- a. All horizontal runs must rise at least ¼ inch per foot toward vent terminal.
- b. Avoid any sags or dips in vent pipe.

C. Air Intake Installation (Direct Vent only)
See Figure 13.

1. General

- a. Use 4 inch diameter single wall metal pipe and fittings available at most heating distributors. Maximum allowable air intake length is 40 equivalent feet. Each elbow is equal to 6 equivalent feet.
 - b. Start at Burner. Work toward air intake terminal.
 - c. Maintain minimum of ¼ inch per foot slope in horizontal run to air intake terminal. Slope down toward air intake terminal.
 - d. Seal all joints gas-tight, using silicone caulk or self-adhesive aluminum tape.
2. After determining location, cut a hole in the wall to accept 4 inch air intake pipe.
 3. Remove the black plastic inlet cover from the right side of the Beckett AFII burner.
 4. Mount the vacuum relief valve tee assembly or 90° elbow into the burner inlet ring. See Figure 13.
 - a. Secure with at least three (3) sheet metal screws evenly spaced around the burner inlet ring.
 - b. Assemble the vacuum relief valve balance weight onto the gate. Refer to the vacuum relief valve manufacturer's instructions.
 - c. Mount the vacuum relief valve into the tee and fasten with a screw and nut in collar tabs. To ensure proper operation, the gate must be level across the pivot point and plumb. Refer to vacuum relief valve manufacturer's instructions.
 5. Install remainder of air intake, securing each joint with at least three (3) sheet metal screws evenly spaced.

6. Install air intake terminal. See Figure 13.
7. Seal all external joints with weatherproof caulk.

D. Air Intake Installation (Indoor Air for Combustion)

1. Remove the black plastic inlet cover from the right side of the Beckett AFII burner.
2. Attach the Air Intake Terminal directly to the burner intake collar.
3. Discard the Vacuum Relief Valve.

Alternate to 1., 2. and 3.:

Keep the black plastic inlet cover in place and discard the Air Intake Terminal and the Vacuum Relief Valve.

V. Electrical and Sequence of Operations

A. ELECTRICAL

1. Install wiring and ground boiler in accordance with requirements of authority having jurisdiction, or in absence of such requirements the National Electrical Code, ANSI/NFPA 70, and/or the CSA C22.1 Electric Code.
2. A separate electrical circuit should be run from the main electrical service with a fused disconnect switch in the circuit.
3. Wiring should conform to Figure 15.

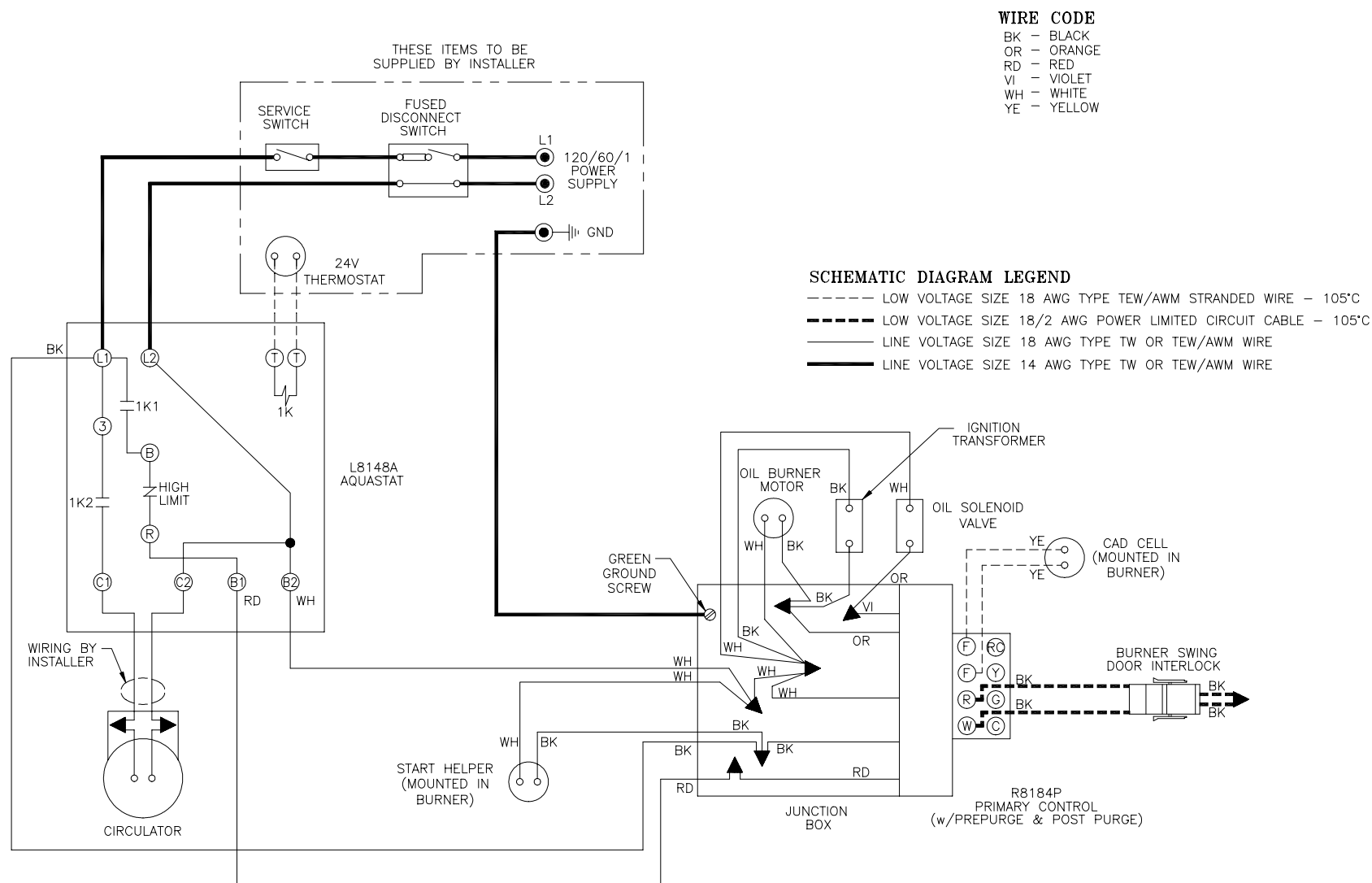
B. SEQUENCE OF OPERATIONS

1. General. A call for heat by the thermostat energizes the L8148A limit control which in turn energizes the R8184P primary control to turn on the burner. The circulator will operate as long as there is a call for heat. If the call for heat is not satisfied and the high limit setting is reached, the circulator will continue to operate, and the burner will stop until the high limit circuit is closed by a drop in boiler water temperature.
2. L8148A Combination Limit control.
The switching action within the L8148A control has one setting, the high limit. The switching relay is controlled by the low voltage room thermostat. On a call for heat, the relay contacts close to complete the line voltage circulator circuit and also the burner circuit if the boiler water temperature is below the high limit setting. The high limit switch shuts off the burner if boiler water temperature exceeds the high limit setting. See Figure 14.
3. R8184P Oil Primary Control.
The R8184P operates the oil burner motor, solenoid oil valve, and the ignition transformer in response to a call for heat from the L8148A limit control.
 - a. A call for heat will energize the burner motor

and ignition transformer.

- b. After a 15 second pre-purge period, in which time a draft is established in the flueways, the oil valve is opened.
 - c. If the burner ignites within 15 seconds from the time the oil valve opens and the CAD cell senses a flame, the burner will operate until the call for heat is satisfied or the setting of the high limit is reached.
 - d. A manual reset button is provided to reset the safety switch after lockout.
 - e. When the call for heat ends, or the CAD cell fails to sense a flame, the oil valve will close. The combustion blower will continue to operate for a postpurge period of approximately two (2) minutes.
4. CAD Cell.
The Beckett AFII burners used on the LEDV Series are supplied with a C554A Cadmium Sulfide (cad cell) Flame Detector to monitor the burner flame and shut down the burner on ignition failure or on flame failure during the run cycle. On either failure, the manual reset button on the R8184P will be tripped.

Figure 14: Control Differential

**NOTES:**

1. IF ANY OF THE ORIGINAL WIRE, AS SUPPLIED WITH THE APPLIANCE, MUST BE REPLACED, IT MUST BE REPLACED WITH WIRE AS SHOWN ABOVE OR ITS EQUIVALENT.

Figure 15: Schematic Wiring Diagram

VI. Oil Piping

A. General

1. Use flexible oil line(s) so that Swing Door can be opened without disconnecting oil supply.
2. A supply line fuel oil filter is recommended as a minimum for all firing rates but a pleated paper fuel oil filter is recommended for the lowest (.6 GPH) firing rate application to prevent nozzle fouling.
3. Use Flared fittings only. Do not use compression fittings.
4. Use of a high efficiency micron oil filter (Garber or equivalent) in addition to conventional filter is highly recommended.

B. Single-pipe Oil Lines.

1. Standard burners are provided with single-stage 3450 rpm fuel units with the bypass plug removed for single-pipe installations.
2. The single-stage fuel unit may be installed single-pipe with gravity feed or lift. Maximum allowable lift is 8 feet. See Figure 16.

TABLE 2: SINGLE-STAGE UNITS (3450 RPM) TWO-PIPE SYSTEMS		
Lift "H" (See Fig. 16)	Maximum Length of Tubing "H" + "R" (See Figure 16)	
	3/8" OD Tubing (3 GPH)	1/2" OD Tubing (3 GPH)
0'	84'	100'
1'	78'	100'
2'	73'	100'
3'	68'	100'
4'	63'	100'
5'	57'	100'
6'	52'	100'
7'	47'	100'
8'	42'	100'
9'	36'	100'
10'	31'	100'
11'	26'	100'
12'	21'	83'
13'	---	62'
14'	---	41'

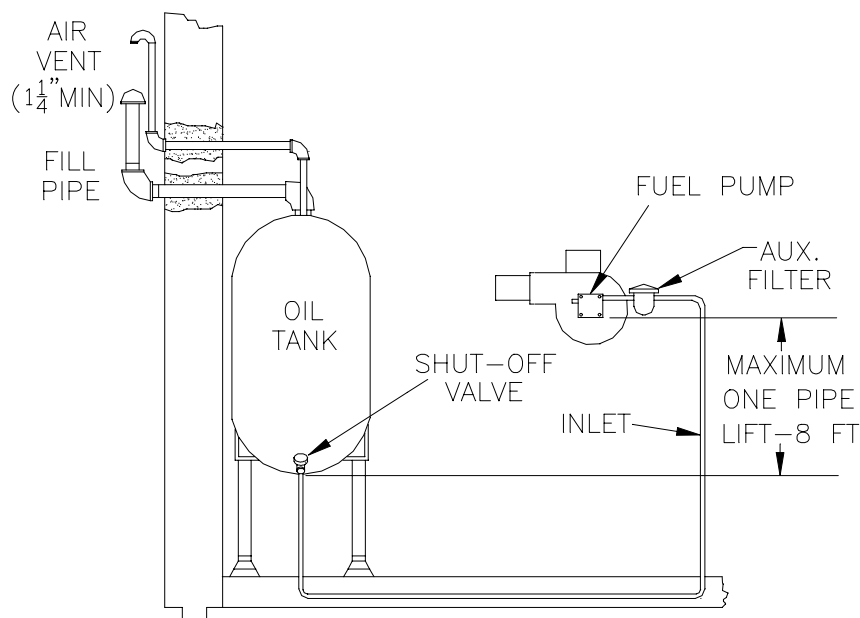


Figure 16: Single-Pipe Installation

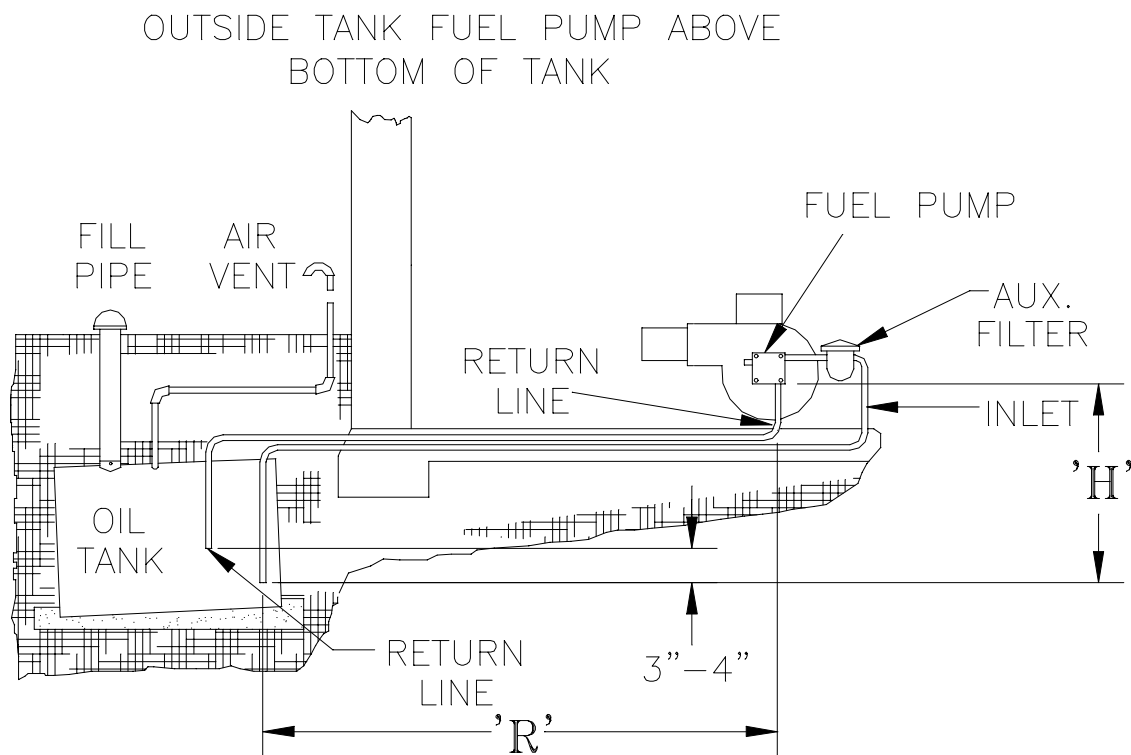


Figure 17: Two-Pipe Installation

C. Two-Pipe Oil Lines.

1. For two-pipe systems where more lift is required, the two-stage fuel unit is recommended. Table 2 (single-stage) and Table 3 (two-stage) show allowable lift and lengths of 3/8-inch and 1/2-inch OD tubing for both suction and return lines. Refer to Figure 17.

TABLE 3: TWO-STAGE UNITS (3450 RPM) TWO-PIPE SYSTEMS		
Lift "H" (See Fig.)	Maximum Length of Tubing "H" + "R" (See Figure)	
	3/8" OD Tubing (3 GPH)	1/2" OD Tubing (3 GPH)
0'	93'	100'
2'	85'	100'
4'	77'	100'
6'	69'	100'
8'	60'	100'
10'	52'	100'
12'	44'	100'
14'	36'	100'
16'	27'	100'
18'	---	76'

VII. System Start-up

WARNING

All boilers equipped with burner swing door have a potential hazard which can cause severe property damage, personal injury or loss of life if ignored. Before opening swing door, turn off service switch to boiler to prevent accidental firing of burner outside the combustion chamber. Be sure to tighten swing door fastener completely when service is completed.

- A. ALWAYS INSPECT INSTALLATION BEFORE STARTING BURNER.**
- B. FILL HEATING SYSTEM WITH WATER.** Refer to Section III, G.
- C. CHECK CONTROLS, WIRING AND BURNER** to be sure that all connections are tight and burner is rigid, that all electrical connections have been completed and fuses installed, and that oil tank is filled and oil lines have been tested.
- D. LUBRICATION** — Follow instruction on burner and circulator label to lubricate, if oil lubricated. Most motors currently used on residential type burners employ permanently lubricated bearings and thus do not require any field lubrication. Water lubricated circulators do not need field lubrication.
- Do not over-lubricate. This can cause as much trouble as no lubrication at all.
- E. SET CONTROLS** with burner service switch turned “OFF”.
1. SET ROOM THERMOSTAT about 10° above room temperature.
 2. PRESS RED RESET BUTTON on R8184P Oil Primary Control and release.
 3. Set high limit dial on L8148 at temperature to suit requirements of installation.
- F. BURNER START-UP**
1. VERIFY burner settings.
 - a. Refer to Table 4.
 2. Open all shut-off valves in the oil supply line to the burner.
 3. Attach a plastic hose to fuel pump vent fitting and provide a container to catch the oil.
 4. REMOVE GAUGE PORT PLUG from fuel pump and install pressure gauge.
 5. REMOVE TEST PLUG IN FLUE COLLAR.
 6. Close the service switch to start the burner. If the burner does not start immediately, check the manual overload switch on the motor, if so equipped, and the safety switch of the burner primary control.

TABLE 4: BECKETT AFII BURNER

Boiler Model	Firing Rate (GPH)	Burner	Air Tube Combination	Delavan Nozzle	Settings		
					Air	Head (stop screw)	Pump Pressure (PSIG)
LEDV-1	0.60	AFII 85	HLX50HD	0.50 x 70°B	2.5	#2	140
LEDV-2	1.00	AFII 150	HLX50HE	0.85 x 60°B	3.5	#3	140
LEDV-3	1.25	AFII 150	HLX50HE	1.00 x 60°B	4.0	#5	140

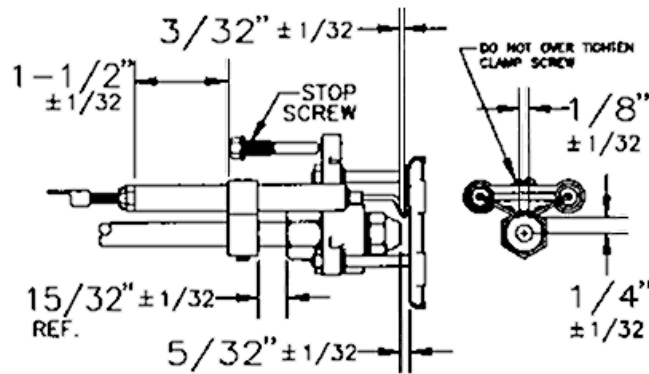


Figure 18: Electrode / Head Setting

7. Bleed the fuel unit when the burner motor starts rotating. To bleed, loosen the vent fitting (with plastic hose attached) and catch the oil in an empty container. Continue to bleed for 15 seconds after oil is free of air bubbles. Tighten the vent fitting when all the air is purged. NOTE: Bleeding might not be necessary with a two pipe system. When vent fitting is closed, burner flame should start immediately.

8. ADJUST OIL PRESSURE

- a. Locate oil pressure adjusting screw and turn screw to obtain 140 PSIG pressure.
- b. DO NOT REMOVE PRESSURE GAUGE until later.

9. ADJUST AIR SETTING on burner for a light orange colored flame. Use a smoke tester and adjust air for minimum smoke (not to exceed #1) with a minimum of excess air. Make final check using suitable instrumentation to obtain a CO₂ of 11.5 to 12.5%. These settings will assure a safe and efficient operating condition. If the flame appears stringy instead of a solid fire, try another nozzle of the same type. Flame should be solid and compact.

10. TURN "OFF" BURNER BY OPENING SERVICE SWITCH. Remove pressure gauge. Install gauge port plug and tighten. Re-start burner.

11. HINTS ON COMBUSTION

- a. NOZZLES — Although the nozzle is a relatively inexpensive device, its function is critical to the successful operation of the oil burner. The selection of the nozzle supplied

with the microTEKDV boiler is the result of extensive testing to obtain the best flame shape and efficient combustion. Other brands of the same spray angle and spray pattern may be used but may not perform at the expected level of CO₂ and smoke. Nozzles are delicate and should be protected from dirt and abuse. Nozzles are mass-produced and can vary from sample to sample. For all of those reasons a spare nozzle is a desirable item for a serviceman to have.

- b. FLAME SHAPE — Looking into the combustion chamber through the flame plug hole, the flame should appear straight with no sparklers rolling up toward the top of the chamber. If the flame drags to the right or left, sends sparklers upward or makes wet spots on the rear door insulation piece, the nozzle should be replaced. If the condition persists look for fuel leaks, air leaks, water or dirt in the fuel as described below.
- c. FUEL LEAKS — Any fuel leak between the pump and the nozzle will be detrimental to good combustion results. Look for wet surfaces in the air tube, under the transformer, and around the air inlet. Any such leaks should be repaired as they may cause erratic burning of the fuel and in the extreme case may become a fire hazard.
- d. AIR LEAKS — Any such leaks should be repaired, as they may cause erratic burning of the fuel and in extreme cases may become a fire hazard.

There are many possible causes of air leaks in oil lines such as:

- i. Fitting leaks due to mis-flared tubing or damaged fitting.
- ii. Fuel line leak due to crushed or bent tubing.
- iii. Filter connection leaks.
- iv. Tank connection leaks.

There are various test kits available to trace air leaks, such as electronic sight glasses. Follow the manufacturers' instructions to find air leaks.

The following actions can eliminate air leaks:

- i. Bleed pump as detailed in System Start-Up Section of this manual.
 - ii. Replace flare fittings.
 - iii. Replace oil supply line.
 - iv. Repair oil filter leaks.
 - v. Replace or repair tank fittings.
- e. GASKET LEAKS — If 11.5 to 12.5% CO₂ with a #1 smoke cannot be obtained in the breeching, look for air leaks around the flue collar. Such air leaks will cause a lower CO₂ reading in the breeching. The smaller the firing rate the greater effect an air leak can have on CO₂ readings.
- f. DIRT — A fuel filter is a good investment. Accidental accumulation of dirt in the fuel system can clog the nozzle or nozzle strainer and produce a poor spray pattern from the nozzle. The smaller the firing rate, the smaller the slots become in the nozzle and the more prone to plugging it becomes with the same amount of dirt.
- g. WATER — Water in the fuel in large amounts will stall the fuel pump. Water in the fuel in smaller amounts will cause excessive wear on the pump, but more importantly water doesn't burn. It chills the flame and causes smoke and unburned fuel to pass out of the combustion chamber and clog the flueways of the boiler.
- h. COLD OIL — If the oil temperature approaching the fuel pump is 40°F or lower poor combustion or delayed ignition may result. Cold oil is harder to atomize at the nozzle. Thus, the spray droplets get larger and the flame shape gets longer. An outside fuel tank that is above grade or has fuel lines in a shallow bury is a good candidate for cold oil. The best solution

is to bury the tank and lines deep enough to keep the oil above 40°F.

- i. HIGH ALTITUDE INSTALLATIONS — Air settings must be increased at higher altitudes. Use instruments and set for 11.5 to 12.5% CO₂.
- j. START-UP NOISE — Late ignition is the cause of start-up noises. If it occurs recheck for electrode settings, flame shape, air or water in the fuel lines.
- k. SHUT DOWN NOISE — If the flame runs out of air before it runs out of fuel, an after burn with noise may occur. That may be the result of a faulty cut-off valve in the fuel pump, or it may be air trapped in the nozzle line. It may take several firing cycles for that air to be fully vented through the nozzle. Water in the fuel or poor flame shape can also cause shut down noises.

G. TEST CONTROLS

WARNING

Before installation of the boiler is considered complete, the operation of the boiler controls should be checked, particularly the primary control and high limit control.

1. CHECK THERMOSTAT OPERATION. Raise and lower thermostat setting as required to start and stop burner.
2. VERIFY PRIMARY CONTROL SAFETY FEATURES using procedures outlined in Instructions furnished with control (See back of Control Cover) or Instructions as follows:

FOR HEATING SERVICEMAN ONLY

a. **Simulate flame failure:**

- Follow the starting procedure to turn on the burner.
- Close the hand valve in the oil supply line.
- Safety switch should lock out in approximately 15 seconds. Ignition should stop and oil valve should close. Blower will stop after postpurge period.
- Push red reset button to reset safety switch.

b. **Simulate ignition failure:**

- Follow the starting procedure to turn on the burner, but do not open the oil supply hand valve.
- Safety switch should lock out in approximately 15 seconds. Ignition and motor should stop and oil valve should close.
- Push red reset button to reset safety switch.

c. **Simulate power failure:**

- Follow the starting procedure to turn on the burner.
- With the burner running, turn off the power to the system by tripping the circuit breaker or removing the fuse.
- Burner should stop.
- Restore power. Burner should start.

- d. If system does not operate as described, go to the TROUBLESHOOTING AND MAINTENANCE section.

3. **VERIFY HIGH LIMIT OPERATION.**

- Adjust thermostat to highest setting.
- Observe temperature gauge. When temperature is indicated, adjust limit to setting below observed temperature. Burner should stop.
- Adjust limit to setting above observed

temperature. Burner should start.

- Adjust thermostat to lowest setting. Adjust limit to desired setting.

4. **CHECK LOW WATER CUTOFF** (if so equipped).

- Adjust thermostat to highest setting.
- With boiler operating, open drain valve and slowly drain boiler.
- Burner should stop when water level drops below low water cutoff probe. Verify limit, thermostat or other controls have not shut off boiler.
- Adjust thermostat to lowest setting. Refill boiler.

H. Boiler is now ready to be put into service.

A leaky system will increase the volume of make-up water supplied to the boiler which can significantly shorten the life of the boiler. Entrained in make-up water are dissolved minerals and oxygen. When the fresh, cool make-up water is heated in the boiler the minerals fall out as sediment and the oxygen escapes as a gas. Both can result in reduced boiler life. The accumulation of sediment can eventually isolate the water from contacting the steel. When this happens the steel in that area gets extremely hot and eventually cracks. The presence of free oxygen in the boiler creates a corrosive atmosphere which, if the concentration becomes high enough, can corrode the steel through from the inside. Since neither of these failure types are the result of a manufacturing defect the warranty does not apply. Clearly it is in everyone's best interest to prevent this type of failure. The maintenance of system integrity is the best method to achieve this.

Section VIII: Service and Cleaning

WARNING

All boiler service and cleaning must be completed with burner service switch turned off. Boilers equipped with burner swing door have a potential hazard which can cause severe property damage, personal injury or loss of life if ignored. Before opening swing door, turn off service switch to boiler to prevent accidental firing of burner outside the combustion chamber. Be sure to tighten swing door fasteners completely when service is completed.

piece. Inspect front and rear door insulation pieces, front door gaskets and combustion chamber liner for damage. Replace any damaged pieces.

4. CLOSE BOILER

CAUTION: Do not start burner unless burner swing door is securely closed. Close door, install fasteners, and tighten securely. Door should be parallel to tubesheet when viewed from top and sides. Reconnect two halves of Swing Door Interlock.

A. General. Inspection, service and cleaning should be conducted annually. Turn off electric power and close oil supply valve while conducting service or maintenance.

B. Firetubes and Combustion Chamber.

1. CLEAN THE FIRETUBES

- For access to fireside of boiler, pull two halves of Burner Swing Door Interlock wiring harness apart, remove fasteners holding door closed and open swing door.
- Prior to cleaning boiler, lay a protective cloth or plastic over combustion chamber liner.
- Using a 1 1/2" diameter wire brush (30" handle), clean firetubes. Measure 15" from end of brush opposite handle, and mark handle. DO NOT allow this mark to go past front end of firetube during cleaning, or brush will hit rear door insulation piece.

2. CLEAN THE COMBUSTION CHAMBER

Using wire or fiber bristle brush, clean inside of combustion chamber. DO NOT let brush hit rear door insulation piece or combustion chamber liner.

3. AFTER CLEANING

- Vacuum debris inside bottom of rear door, remove protective cloth, and vacuum remaining fireside of boiler as necessary. BE CAREFUL not to damage liner or rear door insulation

C. Vent/Air Intake System. Inspect for obstructions, soot accumulation, proper support, and deterioration of pipe, fittings, and joints.

1. Inspect inside of vent pipe.

- Disconnect appliance adapter from boiler flue collar.
- Remove any obstructions and clean with a wire brush as required.
- Reconnect appliance adapter to boiler flue collar as detailed in Section IV: Venting/Air Intake Piping.

2. Clean terminal screens. Terminals must be free of obstruction, undamaged, with screens securely in place.

3. Terminal and wall thimbles (if used) must be weather-tight.

4. Pipe must be full round shape, and show no damage from impact or excessive temperature.

5. Pipe must be supported at minimum 5 foot intervals and must not sag.

6. All vent joints must be secure and watertight.

7. All air intake joints must be secure and airtight.

D. Burner.

- Replace the oil supply line filter.

2. Remove and clean the pump strainer (if applicable).
3. Replace the nozzle with an equivalent nozzle. See Table 4.
4. Clean and inspect the electrodes for damage, replacing any that are cracked or chipped.
5. Clean the combustion head of all lint and soot.
6. Inspect the transformer cables and connectors.
7. Remove and clean the cad cell.
8. Clean the blower wheel and the air control of any lint.
9. Check all wiring for secure connections or insulation breaks.
10. Re-adjust the burner as detailed in Section VII: System Start-up, Paragraph F.

E. Controls. Test Controls for proper operation as detailed in Section VII: System Start-up, Paragraph G.

F. Low water cutoff (if so equipped).

1. Float Type
 - a. Monthly Blowoff. During the heating season, if

an external float type low water cutoff is on the boiler, the blow off valve should be opened once a month (use greater frequency where conditions warrant), to flush out the sediment chamber so the device will be free to function properly.

- b. Annual Service. Float type low water cutoffs should be dismantled annually by qualified personnel, to the extent necessary to insure freedom from obstructions and proper functioning of the working parts. Inspect connecting lines to boiler for accumulation of mud, scale, etc., and clean as required. Examine all visible wiring for brittle or worn insulation and make sure electrical contacts are clean and that they function properly. Give special attention to solder joints on bellows and float when this type of control is used. Check float for evidence of collapse and check mercury bulb (where applicable) for mercury separation or discoloration.

2. Probe Type (Annual Service). Probe type LWCO should be removed once a year, examined and cleaned of any dirt accumulations to assure proper operations. Do not attempt to repair mechanisms in the field. Complete replacement mechanisms, including necessary gaskets and installation instructions, are available from the manufacturer.

Service Notes

IX. Repair Parts

All LEDV Series Repair Parts may be obtained through your local Burnham Wholesale Distributor. Should you require assistance in locating a Burnham Distributor in your area, or have questions regarding the availability of Burnham products or repair parts, please contact your Burnham Regional Sales Office as listed below.

Burnham Corporation Regional Offices

A. Burnham Corporation - Central & Western Regions P.O. Box 3079 Lancaster, PA 17604-3079 Phone: (717) 481-8400 FAX: (717) 481-8408	C. Burnham Corporation - Metropolitan Region P.O. Box 3079 Lancaster, PA 17604-3079 Phone: (717) 481-8400 FAX: (717) 481-8409
B. Burnham Sales Corporation - Northeast Region 19-27 Mystic Avenue Somerville, MA 02145 Phone: (617) 625-9735 FAX: (617) 625-9736	D. Burnham Corporation - Mid-Atlantic Region P.O. Box 3079 Lancaster, PA 17604-3079 Phone: (717) 481-8400 FAX: (717) 481-8409

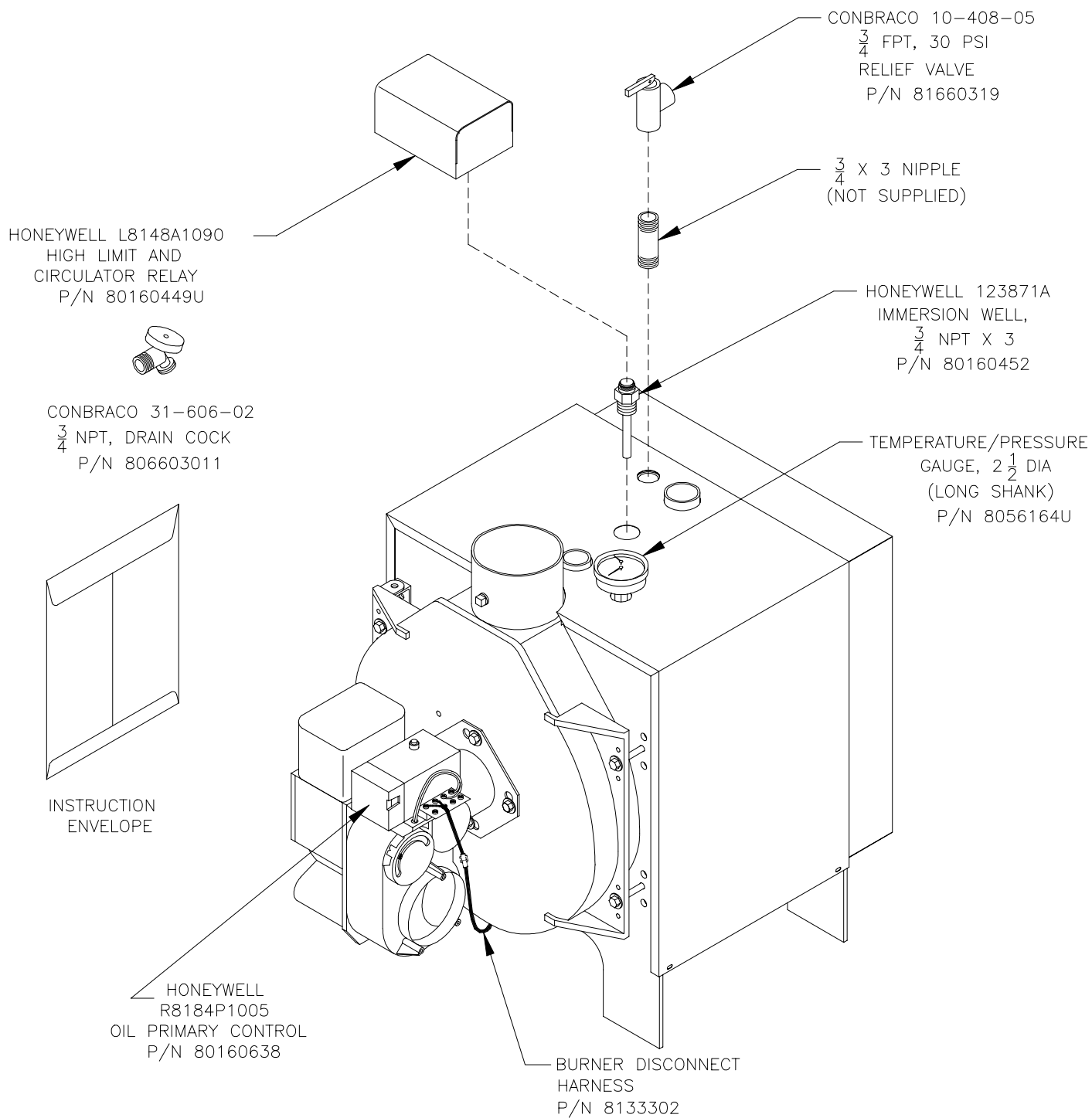


Figure 19: LEDV Boiler Trim & Controls

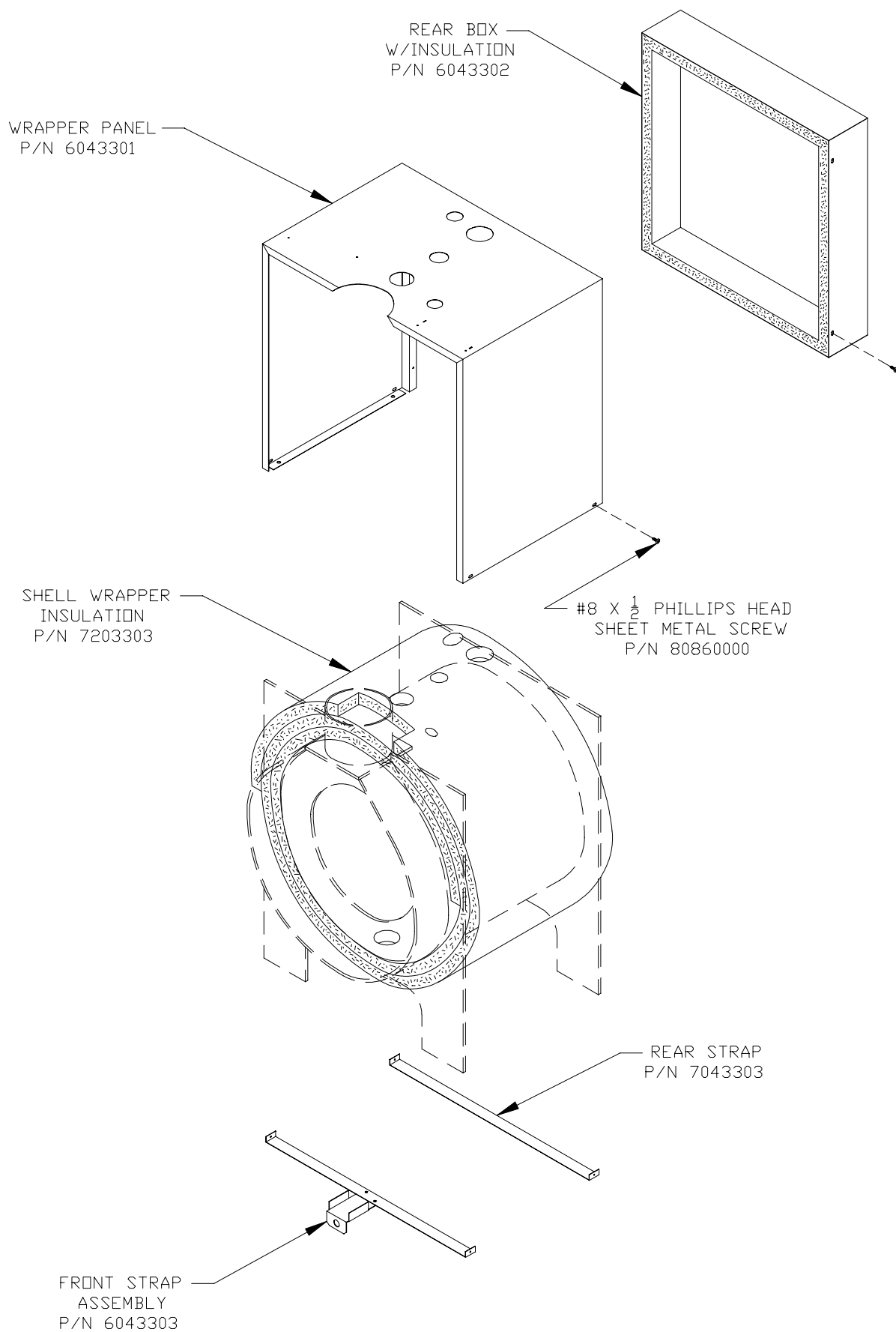


Figure 20: LEDV Boiler Jacket & Insulation

ITEM	DESCRIPTION	QTY.	PART NUMBER
①	SHELL ASSEMBLY	1	6303301
②	COMBUSTION CHAMBER LINER	1	8203305
③	TURBULATOR	14	8113301
④A	FRONT SWING DOOR	1	7303309
④B	FRONT DOOR OUTER INSULATION	1	8203302
④C	FRONT DOOR OUTER ROPE GASKET	1	7203301
④D	FRONT DOOR INNER INSULATION	1	8203301
④E	FRONT DOOR AND FURNACE ROPE GASKET	1	7203305
④F	#6 X $\frac{3}{4}$ DRIVE SCREW	2	80860718
⑤A	HINGE BRACKET	4	7022701
⑤B	HINGE SPACER	2	7303310
⑤C	HINGE PIN	2	80861614
⑤D	HAIRPIN COTTER	2	80861667
⑥A	REAR DOOR	1	8303302
⑥B	REAR DOOR INSULATION	1	8203303
⑥C	REAR DOOR ROPE GASKET	1	7203302
⑦	$\frac{3}{8}$ BRASS PIPE PLUG	1	806603596
⑧	$\frac{5}{16}$ - 18 X $\frac{1}{2}$ CAP SCREW	4	80861304
⑨	$\frac{5}{16}$ - 18 X 1 CAP SCREW	4	80861307
⑩	$\frac{5}{16}$ - 18 X 3 CAP SCREW	2	80861361
⑪	$\frac{5}{16}$ FLAT WASHER	2	80860601
⑫	$\frac{5}{16}$ HEX NUT	12	80860403
⑬	$\frac{1}{4}$ NPT BRASS PIPE PLUG	1	806603542

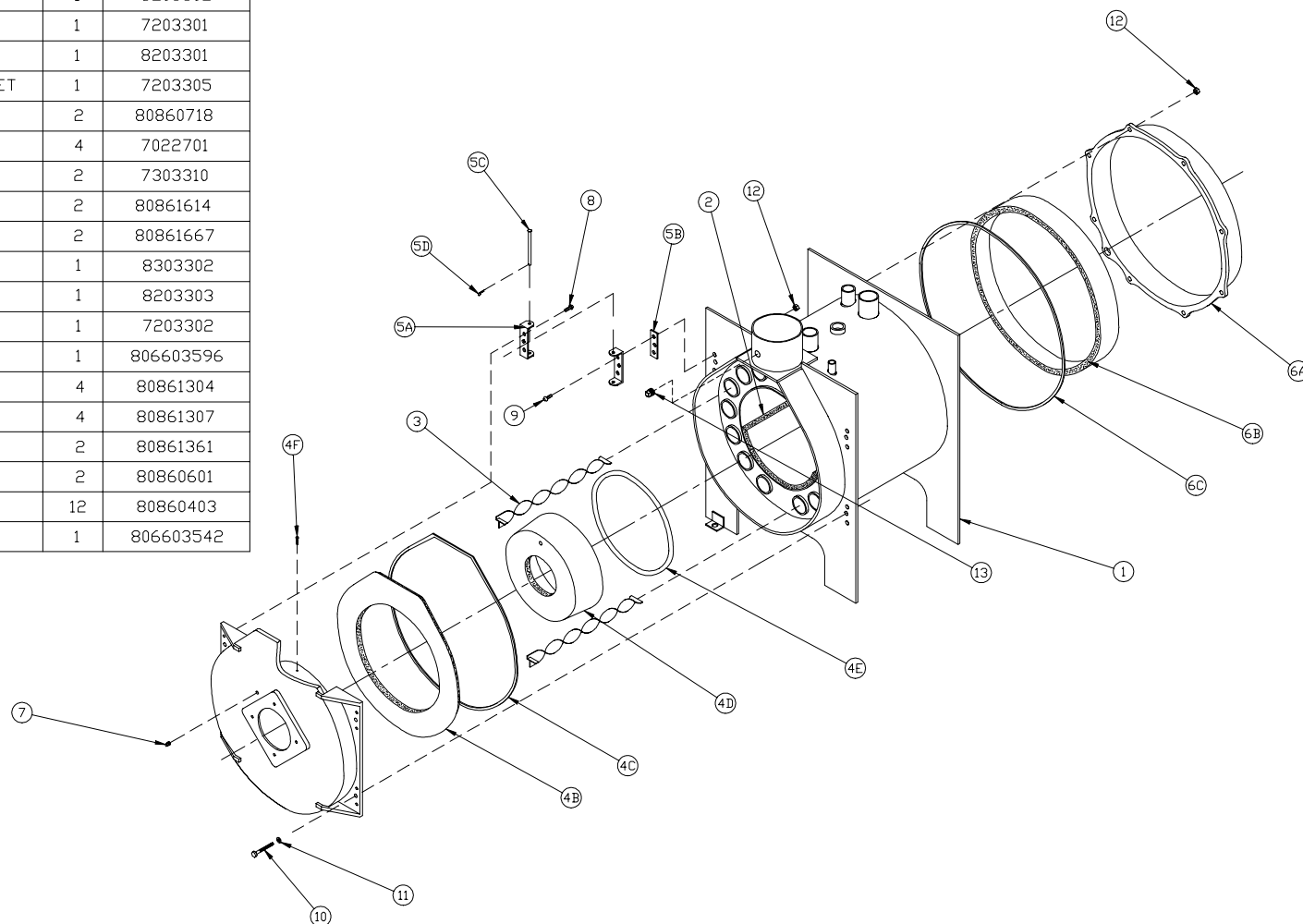
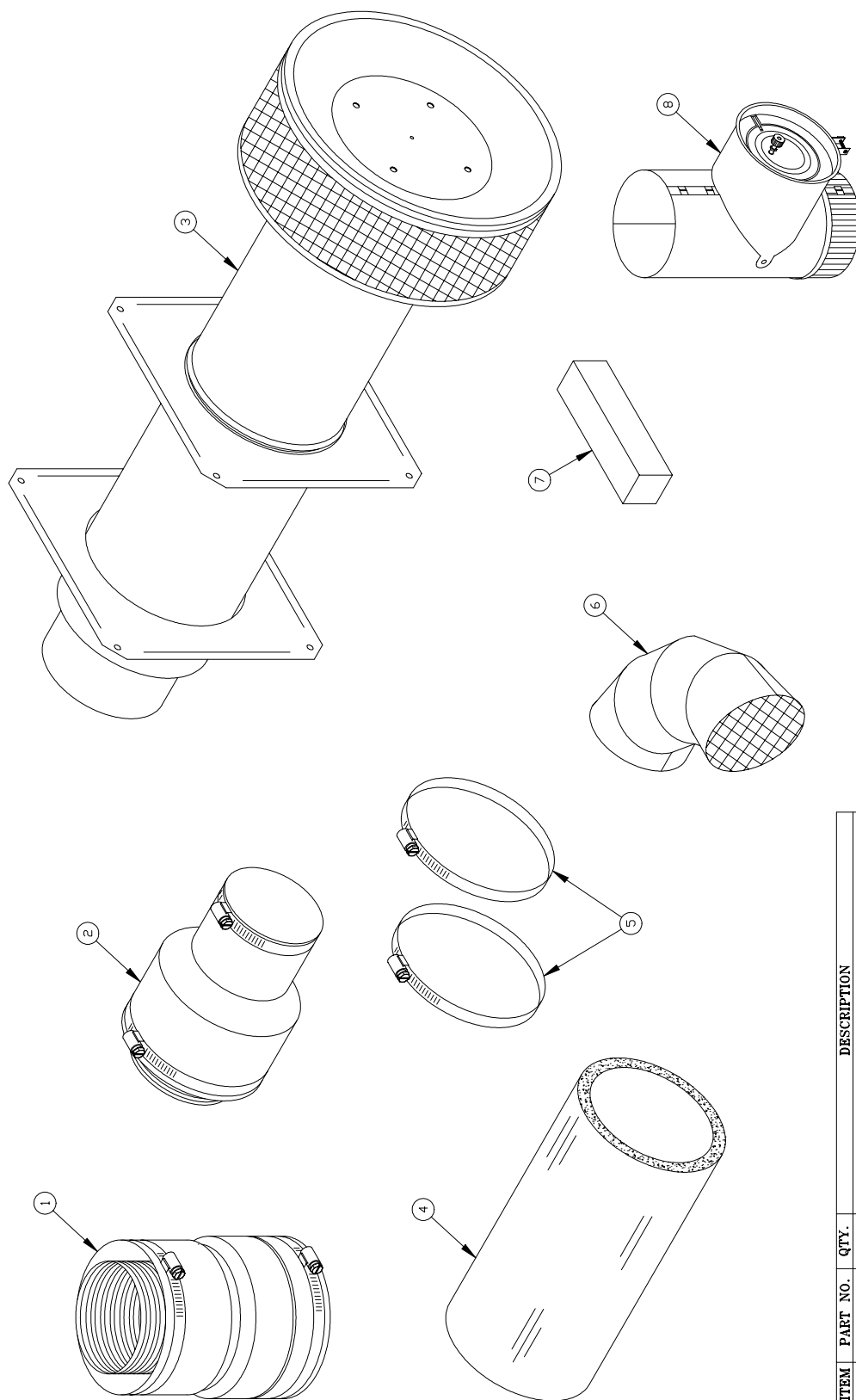
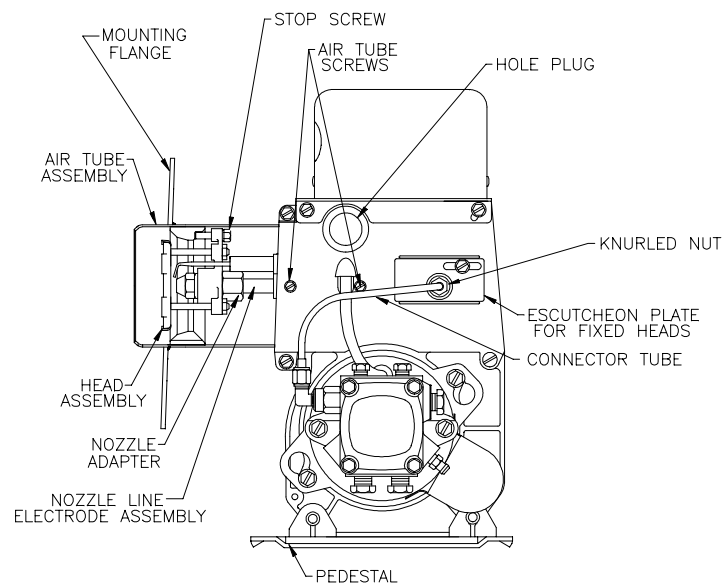


Figure 21: LEDV Bare Boiler Assembly

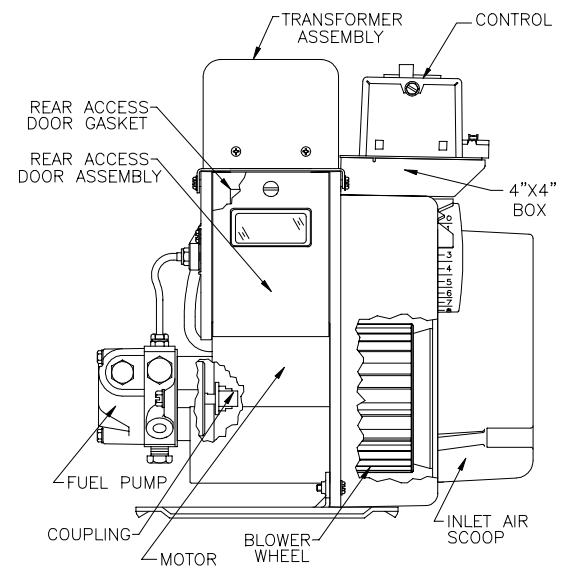


ITEM	PART NO.	QTY.	DESCRIPTION
—	8113306	1	ITEMS 1 THROUGH 7
①	8113307	1	APPLIANCE ADAPTER
②	8113308	1	TERMINAL CONNECTOR
③	8113309	1	TERMINAL ASSEMBLY
④	8113310	1	INSULATION SLEEVE (FOR TERMINAL CONNECTOR)
⑤	8113311	2	6" GEAR CLAMP
⑥	8110402	1	INTAKE TERMINAL
⑦	8056095	1	3 OZ. TUBE OF SILASTIC, RED
⑧	806503034	1	VACUUM RELIEF VALVE

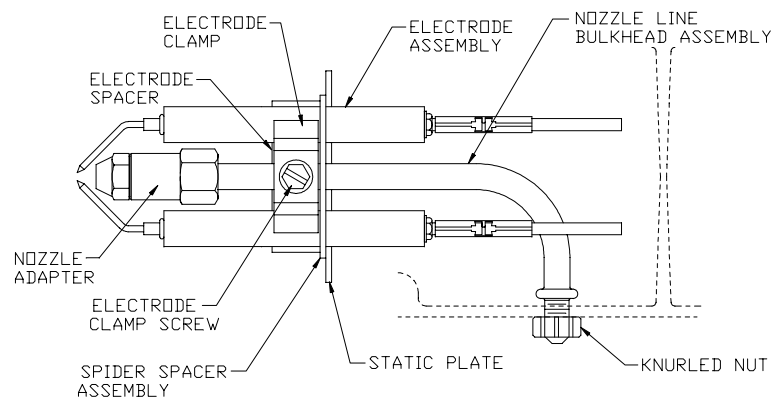
Figure 22: Vent Kit Repair Parts



SIDE VIEW



FRONT VIEW



NOZZLE DETAIL

Figure 23: Beckett AFII Oil Burner Repair Part

For replacement oil burner parts, contact your wholesaler or the burner manufacturer: R.W. Beckett Co., P.O. Box 1289, Elyria, OH 44036
(216) 327-1060 or (800) OIL BURN(645-2876)

BECKETT AFII BURNER REPLACEMENT PARTS			
Part Description	LEDV1	LEDV2	LEDV3
	Beckett Part Number		
Complete Burner (without Primary Control)	BCB5406	BCB5407	BCB5408
Air Tube Combination	HLX50HD	HLX50HE	
Air Tube Screws	4352		
Blower Wheel	21439	21438	
Coupling (Motor to Pump)	21437		
Electrodes (Replacement Kit)	51484U		
Escutcheon Plate	31623		
Stop Screw	3166502	3166503	3166505
Fuel Line	5394		
Fuel Pump (Single Stage, with Solenoid Valve)	21757		
Fuel Pump (Two Stage, with Solenoid Valve)	2583		
Gasket, Flange	31658		
Head Assembly (AFII 6 Slot)	51671	51672	
Hole Plug	2139		
Inlet Air Scoop	51485		
Splined Nut	3666		
Main Housing Assembly	51584	51476	
Motor	21444		
Nozzle Adapter	213		
Nozzle Line Heater	51621		
Rear Access Door	51424GY		
Transformer	51402		
4 x 4 Electrical Box	31613BK		

